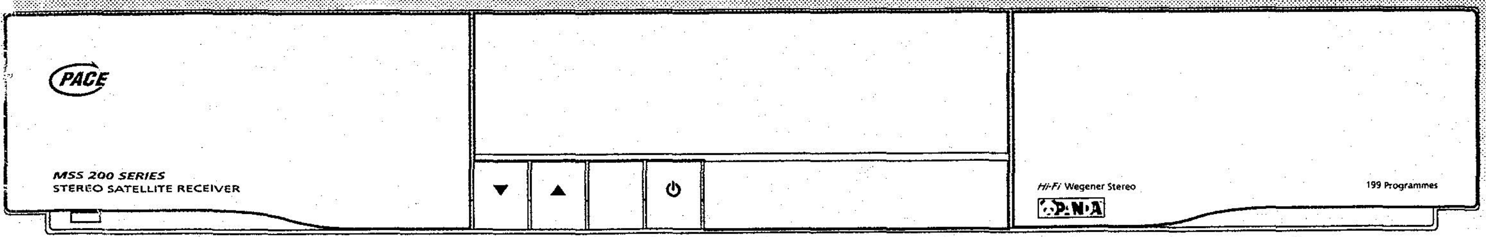
Service Manual

MSS 200-I

INTEGRATED RECEIVER DECODER


PACE
MSS 200 SERIES
STEREO SATELLITE RECEIVER
Hi-Fi Wegener Stereo
199 Programmes
PANDA

PACE MICRO TECHNOLOGY LTD

IMPORTANT - THIS MANUAL COVERS THE MSS 200-I
PLEASE SEE THE IMPORTANT NOTES OPPOSITE

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IMPORTANT NOTES

NOTE 1: STATUS OF THE PRODUCT

The MSS 200-I contains one PCB (some units also have a small microprocessor extension PCB). The main PCB is currently at Revision A2. The PCB's part number is marked on the component side of the PCB. This number can be read on the appropriate the component ident diagram in this manual, where revision A2 is denoted by the characters 102 at the end of the part number. Note that there is a small number of MSS 200-I receivers in the field which have the A1 revision of PCB in them. The differences between Revisions A1 and A2 are slight, primarily involving the tracking in of some components which were retrofitted on the A1 board.

The parts lists and circuit diagrams in this manual include information from all Engineering Change Orders (ECOs) up to and including ECO S000731 and all Production Change Orders (PCOs) up to and including PCO S000351, provided that these ECOs and PCOs had an effectivity date on or before 17.08.94. Further changes will be given in technical bulletins until this manual is re-issued.

If you need to find out the software version number of the receiver, you can display the Download Menu (see page 12) and then press the STORE key to display the second Download screen, which shows the software version number.

NOTE 2: CIRCUIT DIAGRAM

A sheet containing the main circuit diagram is in the pocket inside the back cover of this manual.

NOTE 3: VIDEOCRYPT CIRCUIT DESCRIPTION AND DIAGRAMS

For copyright reasons, these have been printed on special paper on a separate sheet, part of which has been overprinted with broad diagonal stripes to prevent photocopying. Each of these sheets has a unique, traceable serial number. As the card reader is intimately linked with the VideoCrypt circuitry, the description of the card reader circuitry is also given on this sheet, which can be found in the pocket at the rear of the manual.

OUTLINE SPECIFICATION

GENERAL

Number of Programmes	199
Front Panel Control	Standby, programme up/down and authorise buttons
UHF Modulator	CCIR PAL System I, Ch. 21 to 69, preset to Ch. 38
Operating Voltage	187 - 264 V AC, 50 Hz
Power Consumption	35 W (max.)
Dimensions	H = 63 mm, W = 360 mm, D = 263 mm
Weight	3.0 kg (typical, when packed)

CONNECTORS

TV	SCART (RGB and CVBS)
VCR	SCART (CVBS)
DECODER/DESCRAMBLER	SCART (Baseband Output, Audio/Video Input/Output, RGB in)
R and L AUDIO OUT	Phono
MAINS INPUT	2-pin reversible
AERIAL	IEC female
TV	IEC male
LNB	F-type

TUNER

Receiving Frequency Range	Currently 920 - 2050 MHz (shortly to be 700 - 2150 MHz)
Polarity Switching	Vertical: 12.0 - 14.0 V, Horizontal: 16.5 - 20.0 V at 0 - 250 mA with short circuit protection
LNB Tone Switching	Amplitude: 0.6 V ±0.2 V, Frequency: 22 kHz ±4 kHz
Input Impedance	75 Ω
I. F.	479.5 MHz
I. F. Bandwidth	27 MHz
Input Level	-60 dBm to -30 dBm
Image Rejection	40 dB (typically)
Static Threshold	6 dB (typically)
Energy Dispersion Removal	35 dB (min.)

SCART CONNECTORS

Video Output Level	1 V p-p (±2 dB)
Video Output Impedance	75 Ω
Video Frequency Range	50 Hz - 4.8 MHz (±3 dB)
Video De-emphasis (PAL)	to CCIR 405.1 (625 lines)
Baseband Output Level	1 V p-p (±2 dB)
Baseband Frequency Range	30 Hz - 10.5 MHz (±3 dB)
Baseband De-emphasis	PAL/MAC/Flat/Clamped, software selectable
Audio Frequency Range	30 Hz - 12 kHz
Audio Output Level	500 mV rms into 10 kΩ

OPERATING/STORAGE CONDITIONS

Operating Temperature Range	5 - 40 °C
Operating Humidity Range	20 - 80% non-condensing at 25 °C
Storage Temperature Range	-20 - +50 °C
Storage Humidity Range	10 - 90% non-condensing at 25 °C

OUTLINE SPECIFICATION (cont.)

AUDIO

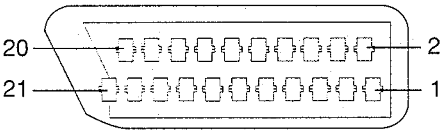
Audio Bandwidth	130, 180, 200, 280 or 380 kHz
Audio De-emphasis	PANDA 1, 50 µs, 75 µs or J17
Tuning Frequency Range	5.00 - 9.00 MHz in 10 kHz steps left and right frequencies independently tunable

KU-Band preset audio modes

Mode	Frequency	De-emphasis	Bandwidth
Stereo A	7.02 & 7.20 MHz	PANDA 1	130 kHz
Stereo B	7.38 & 7.56 MHz	PANDA 1	130 kHz
Stereo C	7.74 & 7.92 MHz	PANDA 1	130 kHz
Stereo D	8.10 & 8.28 MHz	PANDA 1	130 kHz
Mono 1	6.50 MHz	50 µs	180 kHz
Mono 2	7.02 MHz	PANDA 1	130 kHz
Mono 3	7.20 MHz	PANDA 1	130 kHz
Mono 4	7.38 MHz	PANDA 1	130 kHz
Mono 5	7.56 MHz	PANDA 1	130 kHz
Mono 6	7.74 MHz	PANDA 1	130 kHz
Mono 7	7.92 MHz	PANDA 1	130 kHz
Mono 8	8.10 MHz	PANDA 1	130 kHz
Mono 9	8.28 MHz	PANDA 1	130 kHz

PIN DESIGNATIONS FOR SCART CONNECTORS

Socket Viewed from Rear Panel

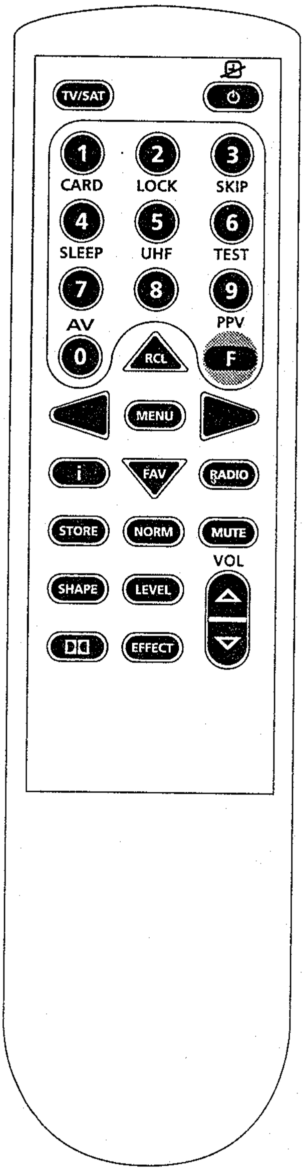


Pin	TV SCART (SK3)	Pin	VCR SCART (SK2)	Pin	DECODER SCART (SK4)
1	R Audio Out	1	R Audio Out	1	R Audio Out
2	R Audio In	2	R Audio In	2	R Audio In
3	L Audio Out	3	L Audio Out	3	L Audio Out
4	Audio Ground	4	Audio Ground	4	Audio Ground
5	Blue Ground	5	Ground	5	Blue Ground
6	L Audio In	6	L Audio In	6	L Audio In
7	Blue Out	7	Not connected	7	Blue In
8	AV Status Out	8	VCR Status In	8	Ext. Decoder Status In
9	Green Ground	9	Ground	9	Green Ground
10	Not connected	10	Not connected	10	Ext. Switch
11	Green Out	11	Not connected	11	Green In
12	Not connected	12	Not connected	12	Serial Data I/O Port
13	Red Ground	13	Ground	13	Red Ground
14	Ground	14	Ground	14	Ground
15	Red/SVHS Chroma Out	15	SVHS Chroma	15	Red In
16	RGB Status Out	16	Not connected	16	RGB Status In
17	Video Ground	17	Video Ground	17	Video Ground
18	Ground	18	Ground	18	Ground
19	Video Out	19	Video Out	19	Baseband Video Out
20	Video In	20	Video In	20	Video In
21	Ground (Casing)	21	Ground (Casing)	21	Ground (Casing)

REMOTE CONTROL HANDSET AND FRONT PANEL CONTROLS

When an operation is described in this manual, it is often given pictorially, as shown right which means: Press the MENU key, then press the 5 key. then press the 2 key.

MENU ⑤ ②



Key(s):	Use:
TV/SAT	To switch between satellite TV and terrestrial TV or VCR (if the receiver, TV and VCR are connected by SCART leads)
⏻	To put the receiver into and out of standby
0 to 9	To select programmes; to move between menus (sometimes to change menu values)
AV 0	To an select external audio/video (AV) source
RCL	To recall the last programme
F	F (function) key - used with the other keys to give "short-cut" methods for certain functions (e.g. LOCK)
MENU	To display Main Menu on screen; to move back up the menu tree to previous menus
▲ ▼	To select menu options (move within menu)
◀ ▶	To step through programmes in normal viewing mode; with F key to scan through programmes; to change values in menus
STORE	To store changes and leave menu to return to normal viewing mode
NORM	To leave menu without storing changes and return to normal viewing mode
i	To display programme information and help text for menus
FAV	To select favourite categories
RADIO	To select satellite radio programmes
MUTE	To mute the sound
SHAPE	To select a sound shape (treble/bass mix) NB: only if TV is SCART connected
LEVEL	This key has no function
DD EFFECT	These keys have no function
VOL △ ▽	Volume (rocker) key

Front Panel Buttons

⏻ - to switch the receiver into and out of standby.

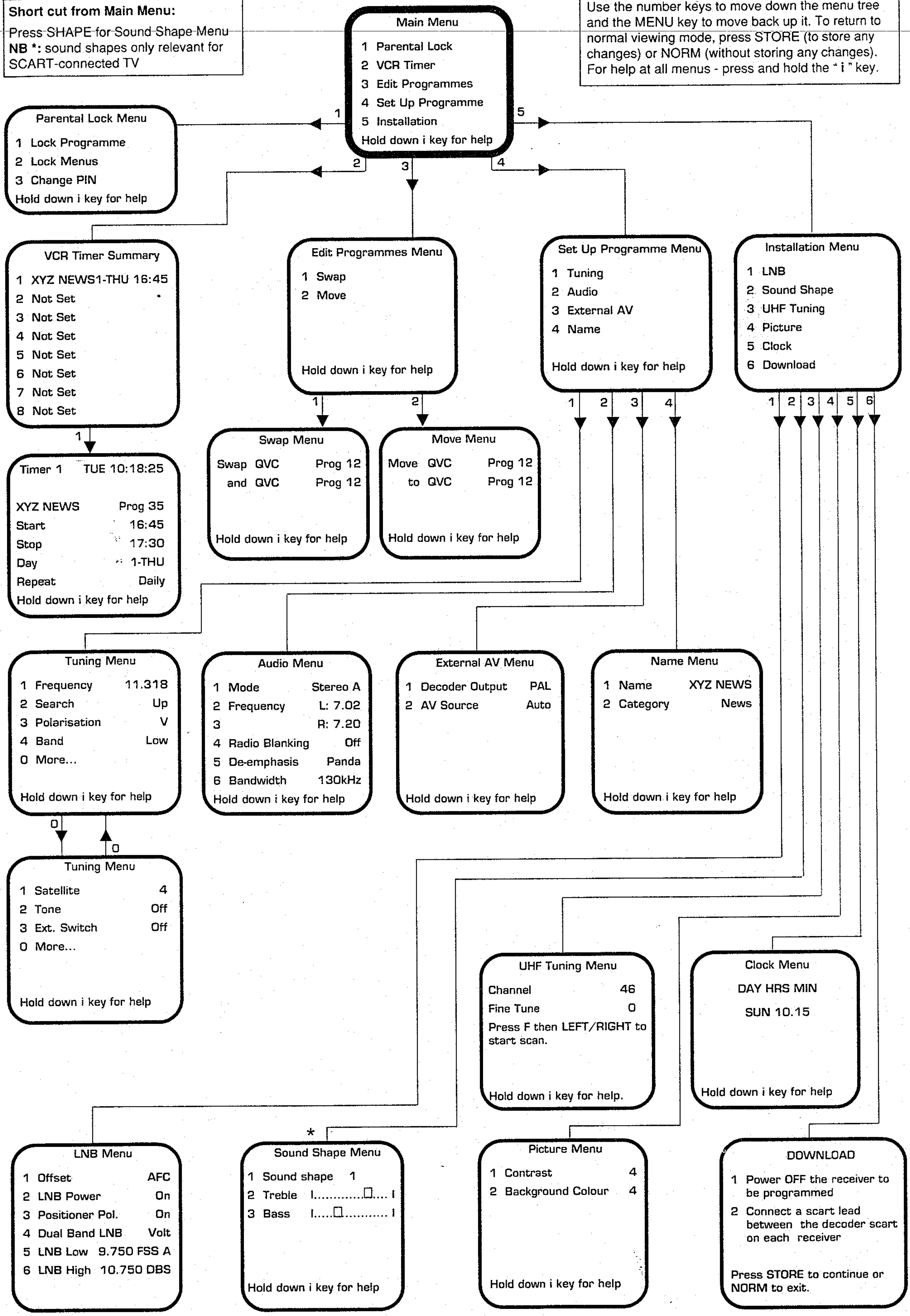
▲ and ▼ - to step through the programmes one at a time

Ⓐ- authorise button for future pay-per-view TV

MENU TREE

Short cut from Main Menu:
Press SHAPE for Sound Shape Menu
NB *: sound shapes only relevant for SCART-connected TV

Use the number keys to move down the menu tree and the MENU key to move back up it. To return to normal viewing mode, press STORE (to store any changes) or NORM (without storing any changes). For help at all menus - press and hold the " i " key.



Main Menu
1 Parental Lock
2 VCR Timer
3 Edit Programmes
4 Set Up Programme
5 Installation
Hold down i key for help

Parental Lock Menu
1 Lock Programme
2 Lock Menus
3 Change PIN
Hold down i key for help

VCR Timer Summary
1 XYZ NEWS1-THU 16:45
2 Not Set
3 Not Set
4 Not Set
5 Not Set
6 Not Set
7 Not Set
8 Not Set

Timer 1 TUE 10:18:25
XYZ NEWS Prog 35
Start 16:45
Stop 17:30
Day 1-THU
Repeat Daily
Hold down i key for help

Edit Programmes Menu
1 Swap
2 Move
Hold down i key for help

Swap Menu
Swap QVC Prog 12
and QVC Prog 12
Hold down i key for help

Move Menu
Move QVC Prog 12
to QVC Prog 12
Hold down i key for help

Set Up Programme Menu
1 Tuning
2 Audio
3 External AV
4 Name
Hold down i key for help

Installation Menu
1 LNB
2 Sound Shape
3 UHF Tuning
4 Picture
5 Clock
6 Download

Tuning Menu
1 Frequency 11.318
2 Search Up
3 Polarisation V
4 Band Low
0 More...
Hold down i key for help

Tuning Menu
1 Satellite 4
2 Tone Off
3 Ext. Switch Off
0 More...
Hold down i key for help

Audio Menu
1 Mode Stereo A
2 Frequency L: 7.02
3 R: 7.20
4 Radio Blanking Off
5 De-emphasis Panda
6 Bandwidth 130kHz
Hold down i key for help

External AV Menu
1 Decoder Output PAL
2 AV Source Auto
Hold down i key for help

Name Menu
1 Name XYZ NEWS
2 Category News
Hold down i key for help

UHF Tuning Menu
Channel 46
Fine Tune 0
Press F then LEFT/RIGHT to start scan.
Hold down i key for help.

Clock Menu
DAY HRS MIN
SUN 10.15
Hold down i key for help

LNB Menu
1 Offset AFC
2 LNB Power On
3 Positioner Pol. On
4 Dual Band LNB Volt
5 LNB Low 9.750 FSS A
6 LNB High 10.750 DBS

Sound Shape Menu
1 Sound shape 1
2 Treble I............□.... I
3 Bass I.....□........... I
Hold down i key for help

Picture Menu
1 Contrast 4
2 Background Colour 4
Hold down i key for help

DOWNLOAD
1 Power OFF the receiver to be programmed
2 Connect a scart lead between the decoder scart on each receiver
Press STORE to continue or NORM to exit.

UHF TUNING

The receiver has been preset at the factory to UHF channel 38, so if you tune the TV (and VCR if necessary) to channel 38, it will automatically be tuned to the receiver. If the TV's channel 38 is not free, then you can tune the receiver to any other channel in the range 21 to 69. If the TV is UHF connected there is no treble/bass control (i.e. no sound shapes).

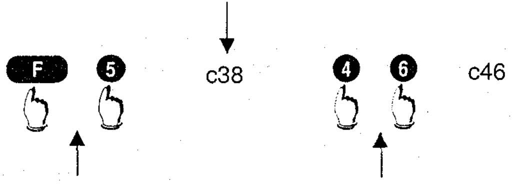
Tuning the Receiver to a UHF Channel

Set up the TV to the required UHF channel and assign it to one of the TV handset keys (e.g. the 5 key). If you find a clear TV channel but do not know its number you can use the "channel scan" feature - see the next section.

Plug the receiver into the mains and bring it out of standby mode.

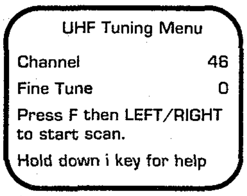
E.g. Tuning to UHF channel 46

Front panel display



This puts the receiver into UHF tuning mode.

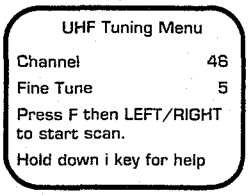
Key in the chosen UHF channel.



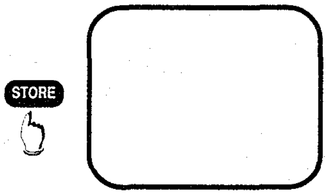
UHF Tuning Menu
Channel 46
Fine Tune 0
Press F then LEFT/RIGHT to start scan.
Hold down i key for help

The menu appears, showing the chosen channel number.

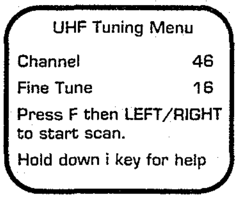
To get the best picture, you can fine tune between -15 and +16.



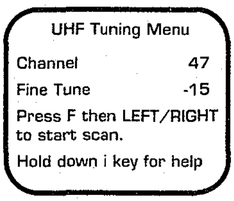
UHF Tuning Menu
Channel 46
Fine Tune 5
Press F then LEFT/RIGHT to start scan.
Hold down i key for help



Note that if the "Fine Tune" option is selected and you press the ▶ key when +16 is displayed, the fine tune value becomes -15, but the channel number increases by one as shown. A channel with a fine tune value of +16 is the same as the next channel with a fine tune value of -15.



UHF Tuning Menu
Channel 46
Fine Tune 16
Press F then LEFT/RIGHT to start scan.
Hold down i key for help



UHF Tuning Menu
Channel 47
Fine Tune -15
Press F then LEFT/RIGHT to start scan.
Hold down i key for help

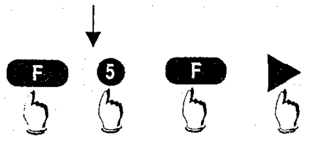
Using the UHF Channel Scan Feature

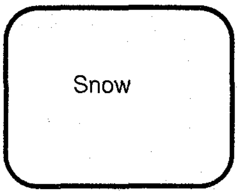
This is an alternative method for tuning the receiver to a UHF channel. It is useful if you find a TV handset key which gives a clear UHF channel, but do not know the number of this UHF channel.

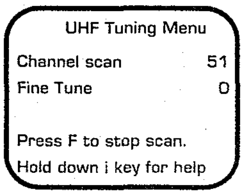
The example below shows channel 51 as the UHF channel which corresponds to the chosen TV handset key.

Plug the receiver into the mains and bring it out of standby mode.

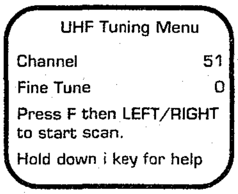
This puts the receiver into channel scan mode.







UHF Tuning Menu
Channel scan 51
Fine Tune 0
Press F to stop scan.
Hold down i key for help



UHF Tuning Menu
Channel 51
Fine Tune 0
Press F then LEFT/RIGHT to start scan.
Hold down i key for help

The TV screen displays only snow until the correct channel number is reached, then the menu appears.

To stop the scan

If you did not stop it at exactly the correct channel to put the menu on the screen, press the ◀ or ▶ key until you do see the menu.

The front panel display keeps changing. c38.......c43......c51

DON'T FORGET - fine tune if required, then press the STORE key to store the UHF tuning settings.

SETTING UP THE RECEIVER FOR THE ATTACHED LNB

IT IS VERY IMPORTANT to check that the LNB option on the LNB Menu corresponds with the LNB on the attached dish antenna.

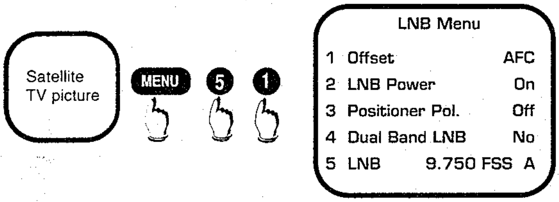
The receiver was preset at the factory as follows:

- LNB 9.750 FSS A

(i.e. for an LNB with a local oscillator whose frequency is 9.750 GHz)

Make sure you know the frequency of the LNB's local oscillator before you connect it to the receiver. Then check that the LNB option at the LNB Menu corresponds with this.

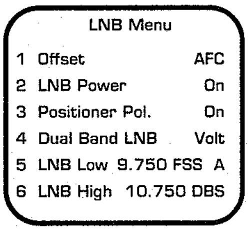
Reaching the LNB Menu



LNB Menu
1 Offset AFC
2 LNB Power On
3 Positioner Pol. Off
4 Dual Band LNB No
5 LNB 9.750 FSS A

If there is a band-switching LNB, you can set the "Dual Band LNB" option to "Tone" or "Volt" (to set "Volt", you must first set the "Positioner Pol." option to "On"). The final two options in the menu then allow you to set the low and high bands to match the attached LNB.

If you set "Tone" or "Volt", a "Band" option appears in the **Tuning Menu** (but if you set "Tone" the "Tone" option disappears from the **Tuning Menu**).



LNB Menu
1 Offset AFC
2 LNB Power On
3 Positioner Pol. On
4 Dual Band LNB Volt
5 LNB Low 9.750 FSS A
6 LNB High 10.750 DBS

What can happen if the LNB is set incorrectly

If the LNB setting does not correspond with the attached LNB, there can be problems as follows:

- if you set "FSS B" at the LNB Menu and your LNB is not suitable for "FSS B" (or, conversely, you have attached an "FSS B" LNB, but set a different value at the menu) then the receiver retunes to a different frequency, so that you see a different programme or even no programme at all on the screen

  (e.g. the programme which was SKY NEWS retunes to become CNN or GALAVISION);

- in other cases the receiver does not retune (i.e. the same programme remains on the screen) but the frequency displayed at the **Tuning Menu** may not be correct.

Changing the LNB Setting for a Single Band LNB

Select one of the following bands or choose the setting "Variable" (see below).

LNB Band	Freq. Range (GHz)	Typical Satellites
9.750 FSS A	10.700 - 11.800	Astra 1A, 1B, 1C, 1D / Intelsat / Eutelsat
10.000 FSS B	10.920 - 11.700	Astra 1A, 1B, 1C / Intelsat / Eutelsat
10.750 DBS	11.700 - 12.500	TDF / TV-Sat / Hispasat
11.475 T-COM	12.500 - 12.750	Telecom 2A, 2B, 1C

The numbers in the LNB band names are the frequencies (in GHz) of the LNB's local oscillator. The second column shows the frequency range over which you **should** tune at the Tuning Menu. We do not recommended that you tune outside these ranges, as performance cannot then be guaranteed.

Changing the "Variable" Setting

Select "Var." (the number next to it flashes). Use the number keys to key in the LNB's local oscillator frequency (in the range 9.050 to 13.000 GHz).

How to check that the LNB option is correct

Store a setting for the LNB at this LNB Menu, and align the dish with the Astra satellite.

In normal viewing mode, key in the programme number for SKY NEWS (consult the programme list), then display the Tuning Menu (by pressing MENU, 4, 1). Check if you can see the SKY logo in the picture on the screen. Check the frequency displayed in the top line of the menu.

If you can see SKY NEWS **AND** the frequency is correct (as on the programme list), then the LNB option at the LNB Menu is correct. If you cannot see the SKY logo **OR** the frequency is wrong, the LNB option has been set incorrectly.

NOTE: *Ensure that you see SKY NEWS and* ***not*** *CNN or GALAVISION, even if the frequency displayed is correct.*

Using a Dual-Band LNB

LNB Type	Setting at "Dual Band LNB" option
Single-band	No
Dual-band, tone switching	Tone
Dual-band, voltage switching	Volt

NOTE: *To set "Volt", you must first set the "Positioner Pol." option to "On". If you set "Volt", you must use an electromagnetic or mechanical polarotor to switch polarisation (e.g. use the receiver with an attached Pace MSP995 dish positioner - see also below).*

When the "Dual Band LNB" option has been set to "Tone" or "Volt", the final two options on the menu allow you to set the low band (LNB Low) and high band (LNB High) of the attached dual-band LNB. The available bands are:

Option	Available settings
LNB Low	9.750 FSS A or 10.000 FSS B
LNB High	10.750 DBS or 11.475 T-COM or Variable

If you select "Var" for LNB High, use the number keys to key in a value between 9.050 and 13.000 GHz.

When the "Dual Band LNB" option has been set to "Tone" or "Volt", there is a "Band" option at the Tuning Menu where you must specify "Low" or "High", as appropriate to the frequency of that programme.

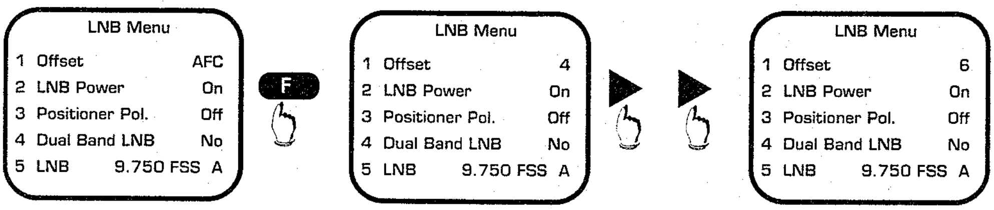
Changing the Offset

You cannot adjust the offset until you have aligned the dish and can see some programmes.

The receiver has been factory-preset for automatic offset (called AFC). This should give a good picture with few or no speckles. You should not need to alter this unless you are trying to receive a very weak signal with a speckled picture.

NOTE: *When the satellite receiver is being used with an attached dish positioner, there may be some drifting (causing poor picture quality) when AFC is on. Switch AFC off to stop the drifting.*

To override AFC, press F then set the offset between -15 to +15 to give the best picture, with an even mix of black and white speckles.



LNB Menu
1 Offset AFC
2 LNB Power On
3 Positioner Pol. Off
4 Dual Band LNB No
5 LNB 9.750 FSS A

LNB Menu
1 Offset 4
2 LNB Power On
3 Positioner Pol. Off
4 Dual Band LNB No
5 LNB 9.750 FSS A

LNB Menu
1 Offset 6
2 LNB Power On
3 Positioner Pol. Off
4 Dual Band LNB No
5 LNB 9.750 FSS A

Turning the LNB Power On/Off

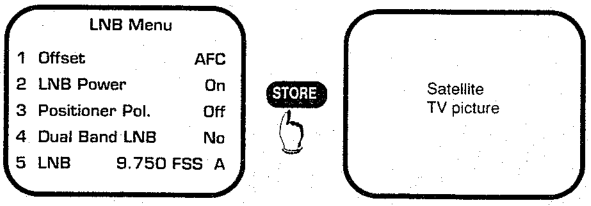
Set the "LNB Power" option to "On" to provide power to the LNB unless the LNB is on a communal antenna (in which case set "Off", as it must NOT receive power from the receiver).

Setting the Positioner Pol. Option

Set this to "On" if you have attached a Pace MSP995 positioner and wish the polarisation you set at the Tuning Menu to pass down the SCART lead to the positioner (see also the positioner manual). In this case the receiver uses the polarotor control circuitry within the positioner to change polarisation by means of an electromagnetic or mechanical polarotor attached to the positioner. Note that this is the only means of polarisation switching available if you wish to use voltage to switch a band-switching LNB. For this reason, you can only select "Volt" at the "Dual Band LNB" option if you have first set "On" at the "Positioner Pol." option.

Storing the LNB settings

NOTE: *To leave the menu without storing your changes, press the NORM key.*

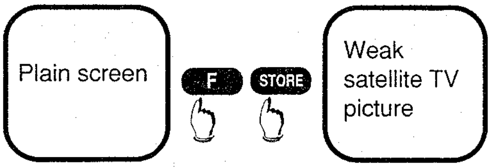


LNB Menu
1 Offset AFC
2 LNB Power On
3 Positioner Pol. Off
4 Dual Band LNB No
5 LNB 9.750 FSS A

USEFUL FUNCTIONS FOR INSTALLATION

Cancelling a Plain Screen

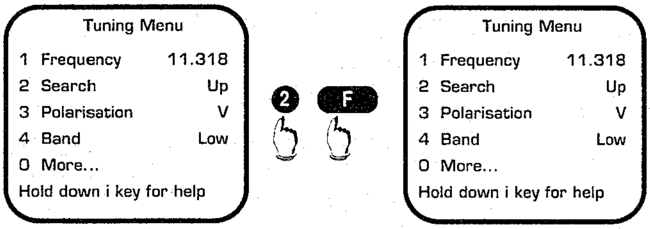
When you are tuning in to weak signals the receiver may force a plain colour onto the TV screen and display "NO SIGNAL". To help you to see weak signals, cancel this plain screen as follows, (this only works if there is no menu on the screen):



NOTE: *To redisplay the plain screen, press F, STORE again.*

Using the Fast Frequency Scan Feature

Press MENU, 4, 1 to display the Tuning Menu and start the fast scan as follows:



Tuning Menu
1 Frequency 11.318
2 Search Up
3 Polarisation V
4 Band Low
0 More...
Hold down i key for help

Tuning Menu
1 Frequency 11.318
2 Search Up
3 Polarisation V
4 Band Low
0 More...
Hold down i key for help

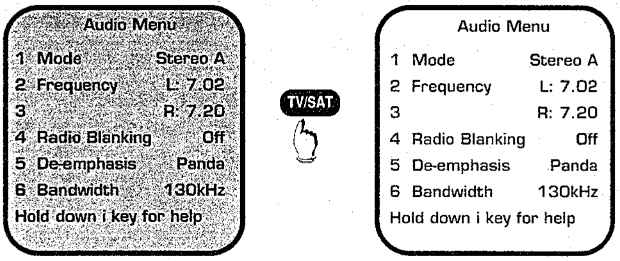
Fast scan mode

In "fast scan" mode the receiver scans quickly through the whole frequency band and weak signals do not force a plain screen. This can be a useful way to align the dish if you have no installation meter.

Look at the TV screen and move the dish until you can see stronger signals, then press the F key to stop the fast scan and return to the Tuning Menu.

Forcing a Plain Background for Menus

Sometimes, when there is a scrambled or distorted picture on the screen, a menu may be difficult to read.
You can force a plain background as follows:



Audio Menu
1 Mode Stereo A
2 Frequency L: 7.02
3 R: 7.20
4 Radio Blanking Off
5 De-emphasis Panda
6 Bandwidth 130kHz
Hold down i key for help

Audio Menu
1 Mode Stereo A
2 Frequency L: 7.02
3 R: 7.20
4 Radio Blanking Off
5 De-emphasis Panda
6 Bandwidth 130kHz
Hold down i key for help

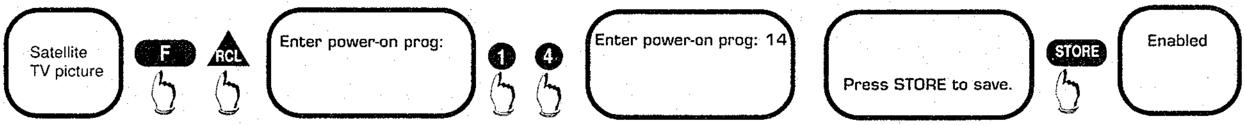
distorted background plain coloured background

NOTE: *To remove the plain background, press the TV/SAT key again.*

Setting Up the Receiver to Display a Programme when it is Powered Up

Generally when you plug the receiver into the mains it will power up in standby mode. The feature described here can be useful if the receiver is in a communal (SMATV) system. We do not recommend it for individual installations.

The example given is for programme 14:



Enter power-on prog:

Enter power-on prog: 14

Press STORE to save.

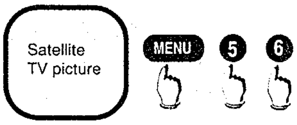
Enabled

NOTE: *To cancel the feature, repeat the above process.*

DOWNLOAD

You use this feature to "program" another receiver of the same type. During the download, all of the information stored in the first receiver's internal memory is transferred to the second receiver. This includes all the settings which have been made and stored at the menus, except the clock setting and any timers that have been set up.

Reaching the Download Menu



IMPORTANT NOTE: You must follow the on-screen instructions exactly, otherwise errors may occur.

Display the Download Menu on the receiver you are downloading **from**.

Turn off the power to the receiver you want to download **to**.

Connect a SCART lead between the DECODER connector on the rear panel of each receiver.

Press the STORE key.

Turn on the power to the receiver you want to download **to**.

NOTE: *The number on the screen is the software version number.*

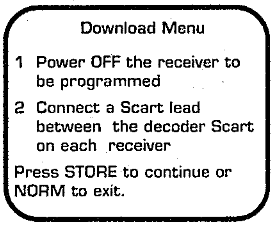
Press the STORE key.

NOTE: *At any stage up to this pressing of the STORE key, you can stop the download by pressing the NORM key.*

During download "global" information is transferred first, then all the programme information. Messages appear on the screen to tell you which programme is currently being transferred. Download takes about 15 seconds.

When the message "Download COMPLETE" appears, disconnect the receiver you have downloaded **to**. Press the STORE key to redisplay the Installation Menu if you wish to download to another receiver, otherwise press NORM to return to normal viewing mode.

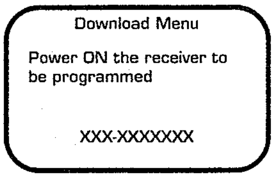
If the download fails for any reason, the message "Download ERROR" appears.


Download Menu

1 Power OFF the receiver to be programmed

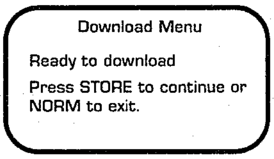
2 Connect a Scart lead between the decoder Scart on each receiver

Press STORE to continue or NORM to exit.


Download Menu

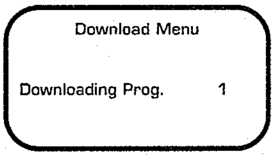
Power ON the receiver to be programmed

XXX-XXXXXXX

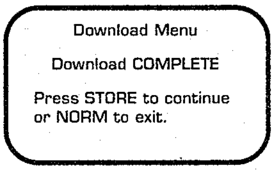

Download Menu

Ready to download

Press STORE to continue or NORM to exit.


Download Menu

Downloading Prog. 1


Download Menu

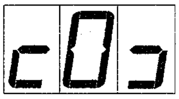
Download COMPLETE

Press STORE to continue or NORM to exit.

RESETTING THE PIN AND GLOBAL RESET

The factory-set PIN is 1234. You can reset any customised PIN to the factory default as follows:

At the wall socket, disconnect the receiver from the mains supply. Hold down the ⏻ button **on the receiver's front panel** while you reconnect the receiver at the wall socket. You need to hold down the ⏻ button until the symbols shown below disappear from the front panel display.



When the PIN is reset, the following also occur: any locked programmes or menus become unlocked, and, because the receiver has been powered down, the clock and any timers are no longer set.

Global Reset

To perform a global reset: Press the MENU key to put the Main Menu on the screen, then press the following keys in quick succession: 0 then STORE then ► then ◄.

A global reset causes the following to happen:

- All the options in the "Installation" sub-menus are reset to their factory-set values.
- The PIN is reset to 1234 and, if locked, the menus become unlocked (locked programmes are not affected). As you have not powered down the receiver for a global reset, the clock and timer settings are not lost.
- The "power-on" volume is reset to "half way"; the sound shapes are reset to those depicted in the User Manual.
- If a "power-on" programme has been set (see page 11), the receiver is reset to power up into standby.
- If you have a receiver which had special preset audio modes downloaded at the factory, these are reset to the standard Astra audio modes listed on page 5.

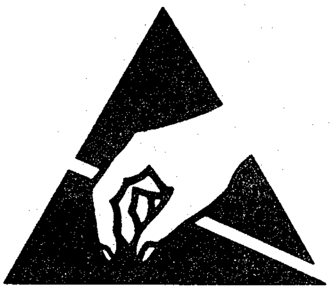
NOTE 1: As the UHF channel resets to 38, fine tune 0, you may need to do UHF tuning again (see page 8).

WORKING WITH CHIP COMPONENTS

Handling Electrostatic Sensitive (ES) Devices

Many semiconductor devices, such as integrated circuits and field effect transistors, can easily be damaged by static electricity. The following precautions should be observed when ES devices are being handled.

- Always use a grounded tip soldering iron and anti-static type solder removal devices.
- Before handling a device, discharge any electrostatic charge on your body by touching a known earth point - preferably use an earthed bench mat or ground mat together with a wrist strap.
- Do not remove an ES device from its protective packing until you are ready to fit it. Touch the protective material to the chassis or the assembly in which the ES device is to be installed, before removing the device from its packing.



General Precautions for Handling and Storing Chips

Do not handle chips with your bare hands as this can cause oxidation on the chip's terminals which leads to poor soldering.

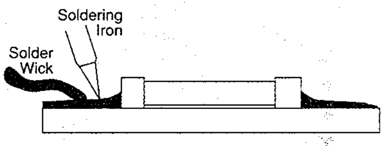
Do not store the chips in any of the following areas, as oxidation will occur and the capacitance and resistance will be affected:

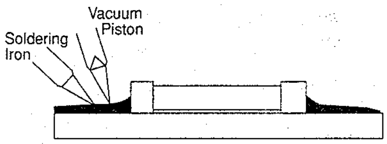
- areas with sulphur or chlorine gas;
- direct sunlight;
- areas of high temperature and/or high humidity.

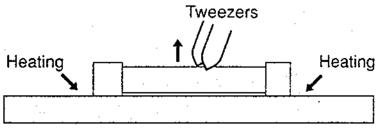
Rough handling of circuit boards containing surface mount devices can cause damage to the components as well as the board; never bend or flex such boards.

Do not heat or cool the boards unnecessarily, as the board materials expand and contract by differing amounts which can cause the components and solder connections to be stressed.

Never rub or scrape chip components as this can change their value. Do not slide the board across any surface.







General Precautions for Attaching and Removing Chips

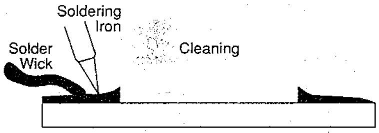
When using a soldering iron, take care and apply suitable pressure.

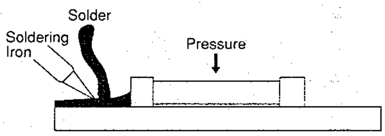
For preference, use a soldering iron rated at approx. 30 W with a thermostatic control to give soldering temperatures of approx. 225 to 250 °C.

Do not re-use chips which have been removed from the board.

When attaching chips, solder as quickly as possible so as not to damage the terminals and body of the chip. Do not touch the terminals directly with the soldering iron.

While soldering, keep the chip's body in contact with the board.





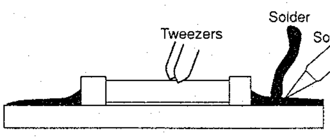
Removing a Chip

Heat the solder for 2 to 3 seconds at each terminal of the chip.

Remove the molten solder with solder wick.

Holding the chip with a pair of tweezers, remove it gently from the board while the solder at each terminal is molten.

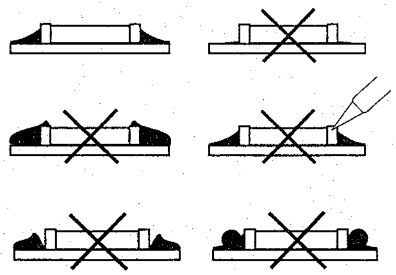
Wick off all excess solder from the board, so that it is ready for the mounting of new components.



Attaching a Chip

Place the chip in the correct position and temporarily solder one terminal to the copper surface.

Holding the chip body with a pair of tweezers to position it accurately, complete the soldering at each terminal in turn.



CIRCUIT DESCRIPTION

The receiver has all its main components on one printed circuit board. Some receivers may have an extension board in place of the main microprocessor U4 (see also the section entitled "Control Circuitry" later in this circuit description)

The adjacent "main" block diagram shows the main functional blocks. The VideoCrypt circuitry is on the main PCB but, for copyright reasons, the VideoCrypt decoder functions are given in a block diagram on a separate sheet. (See the pocket on the rear cover of the manual.) This separate sheet also contains a VideoCrypt circuit diagram and descriptions of the VideoCrypt and card reader functionality. There is also a separate block diagram for the audio circuitry (on page 24).

TUNER AND VIDEO PROCESSING

Tuner

When a programme is selected via the handset, data received by the sensor IR1 is fed, as TTL level data, to the microprocessor U4 which in turn supplies tuning data to a frequency synthesiser within the video processor U16. This synthesiser forms the reference oscillator for the phase locked loop which controls the local oscillator in the tuner (TUNER1). The prescaler output of the tuner is obtained by dividing the local oscillator frequency by 128.

The local oscillator is set 479.5 MHz higher in frequency than the chosen programme and is mixed with the incoming signal. The signal is then amplified by an IF stage centred at 479.5 MHz with a bandwidth of 27 MHz. The 479.5 MHz FM signal is then demodulated in TUNER1 to give the required composite video baseband signal (CVBS) output.

The frequency synthesis is performed by U16, which receives divider ratio data for the required programme at pin 15 via the 3-wire serial bus from the microprocessor U4. The data is on pin 15, clock on pin 19 and select on pin 11 of U16. The synthesiser generates a reference frequency from the 4 MHz clock input on pin 12 of U16. This 4 MHz clock input is from the 16 MHz oscillator X1, which is divided by 2 in divider U22A and again by 2 in U22B. The prescaler input on pin 18 of U16 is divided down according to the divider ratio data sent from U4 and compared with the generated reference (see also the diagram on page 15). The error signal from this phase locked loop (pulses on pin 16 of U16) is integrated by Q23, C142, R193, R192 and R191. These determine how much of the 30 V supply appears as the tuner control voltage on pin 15 of TUNER1. The 5 V supply to the tuner is on pin 12.

To compensate for the LNB's local oscillator frequency conversion offsets, information on the position of the signal relative to the 27 MHz bandpass filter within the tuner passes from pin 10 of TUNER1 to pin 35 of U4. The frequency synthesised within U16 is then varied under control from U4. This automatic frequency control (AFC) keeps the signal central in the 27 MHz bandpass filter.

In dual-input models of the receiver, the Tuning Menu can be used to specify whether a programme is received via LNB 1 or LNB 2. The line LNB_1/2 controls both the supply and select for the LNBs and comes from pin 13 of U17 (the colour graphics generator IC, part of which acts as a port expander for U4). Pin 6 of TUNER1 is the select line for LNB 1 and it is enabled by Q22; pin 4 is the select line for LNB 2 and it is enabled by Q21. Power to the LNBs passes through the tuner via pin 5 for LNB 1 and pin 3 for LNB 2. There are further details about the LNB supply in the SMPS circuit description on page 21.

The baseband signal from pin 13 of the tuner is coupled into the audio circuitry via Q56. It also passes to the base of Q55. From Q55 the signal path depends on whether the receiver can be used with a C-band LNB and on whether a dual bandwidth tuner is fitted. These options are described on page 15.

If U19 (A and B), Q54 and associated components are not fitted, then C-band cannot be selected at the LNB Menu and 27/36 MHz bandwidth selection is also not available. In this case, the normal video signal passes from the emitter of Q55 via C238, J5 and R300 to pin 3 of U16.

The baseband video enters a pre-amplifier within U16. The gain of the pre-amplifier is set by R299 and R300 and the input is biased at about 2.5 V by R298 from VMID on pin 21. The pre-amplifier output on pin 2 is inverted. There are then two paths for the signal: one to give baseband output at pin 22 of U16 and the other to give video output at pin 6. See the sections "Baseband Amplification" and "Video Processing within U16" respectively for details.

C-Band Option

Q55 is configured to give both normal video (at the emitter) and inverse video (at the collector). These pass to pins 5 and 3 respectively of U19A which is under the control of the line CBAND (from pin 12 of U17). If the LNB has been set to C-Band at the LNB Menu, the inverse video signal passes through U19A from pin 3 to pin 4. For the other LNB settings, the normal video passes through U19A from pin 5 to pin 4. (Note that U19 is a 4053 switch, a diagram of which is given on page 19.)

Dual Bandwidth Tuner

The video signal passes from U19A via Q54 and gain switch U19B, which is controlled by the line 27/36. This line comes from the line BANDWIDTH from pin 20 of U4 via Q64 and also passes to pin 14 of the tuner. If a dual bandwidth tuner is fitted this line selects between the two bandwidth options; for a single bandwidth tuner Q64 and associated components are not fitted and the line BANDWIDTH has no function. For an 18/27 MHz tuner the video gain of the receiver is the same at both bandwidths, but for a 27/36 MHz tuner the gain must be reduced if 36 MHz is set at the Tuning Menu (as the output voltage from the tuner is increased in this case). The gain reduction is achieved using R322 and R323 to divide down and the switch U19B controls the selection between 27 MHz (where no gain reduction is required) and 36 MHz. If an 18/27 MHz tuner is fitted, R322 is zero ohms so that no gain reduction occurs.

Baseband Amplification

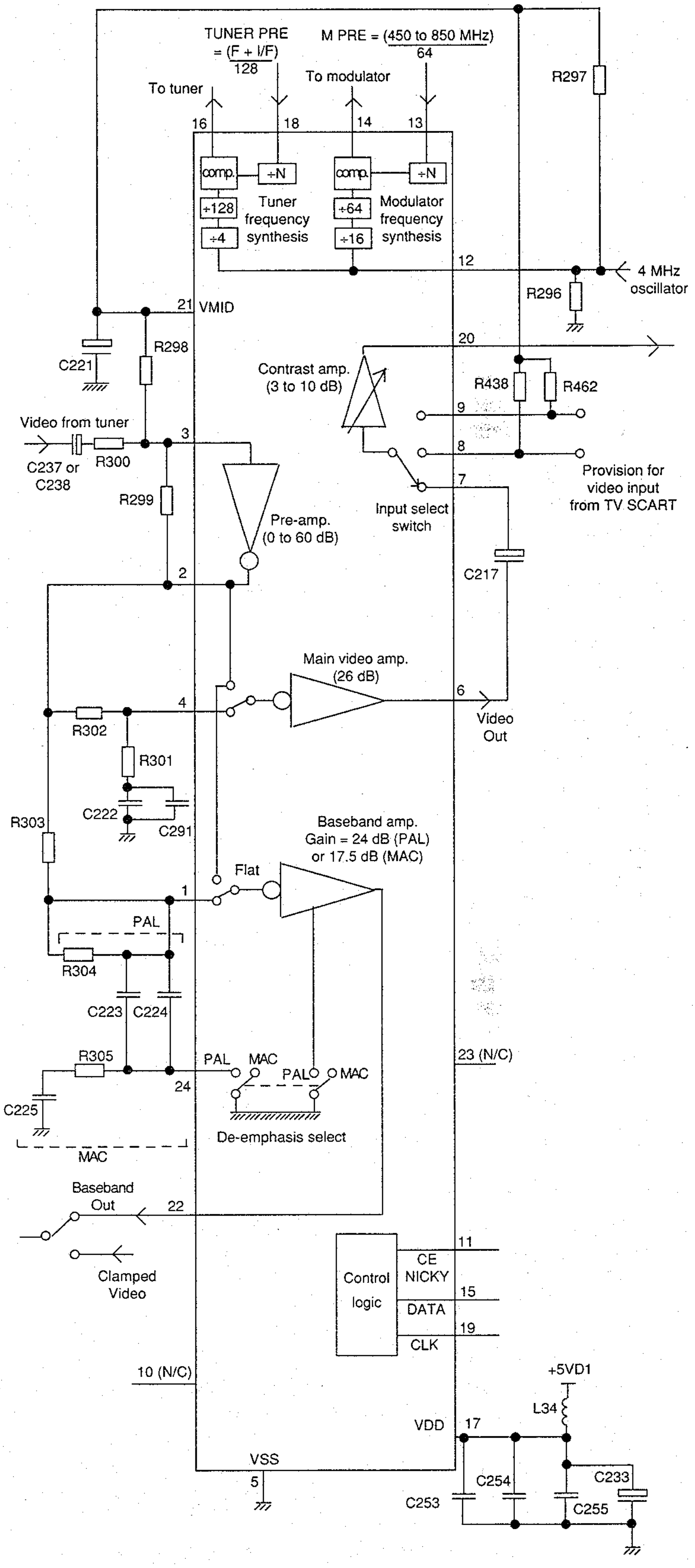
MAC and PAL transmissions use different pre-emphasis. The de-emphasis required for the incoming signal format, PAL or MAC, can be selected at the Decoder Output option of the External AV Menu (a sub-menu of the Set Up Programme Menu). This PAL/MAC selection switch is within U16 (under control from U4) and is on pin 24 of U16.

If PAL is selected, the response of the amplifier is modified by the PAL de-emphasis circuit R304, C223 and C224.

If MAC is selected, the response of the amplifier is modified not only by R304, C223 and C224 but also by R305 and C225 to give MAC de-emphasis.

The signal re-enters U16 at pin 1 and passes through the baseband amplifier whose gain is automatically reduced for MAC.

At the External AV Menu, PAL and MAC are not the only values which can be set for the Decoder Output option; it is also possible to set “Flat” or “Clamped”. If “Flat” is selected, the output from the pre-amp in U16 is switched straight through to the baseband amplifier, as shown in the diagram right, thereby by-passing the PAL and MAC de-emphasis circuitry described above.


TUNER PRE = (F + I/F) / 128
M PRE = (450 to 850 MHz) / 64
To tuner
To modulator
16
18
14
13
comp.
÷N
÷128
÷4
Tuner frequency synthesis
÷64
÷16
Modulator frequency synthesis
R297
12
4 MHz oscillator
R296
21 VMID
C221
R298
20
Contrast amp. (3 to 10 dB)
R438
R462
9
8
7
Video from tuner
3
C237 or C238
R300
R299
Pre-amp. (0 to 60 dB)
Input select switch
Provision for video input from TV SCART
C217
2
Main video amp. (26 dB)
4
6
Video Out
R302
R301
C222
C291
R303
Baseband amp. Gain = 24 dB (PAL) or 17.5 dB (MAC)
Flat
1
PAL
R304
C223
C224
R305
PAL
MAC
PAL
MAC
24
C225
De-emphasis select
MAC
23 (N/C)
Baseband Out
22
Clamped Video
Control logic
11
CE
NICKY
15
DATA
19
CLK
10 (N/C)
+5VD1
L34
VDD
17
VSS
5
C254
C233
C253
C255

The baseband amplifier output is inverted and is on pin 22 of U16. If PAL, MAC or Flat has been selected for the Decoder Output option at the External AV Menu, the base of Q68 is at a nominal 4 V (set by R382 and R383). This is a higher level than the base of Q67, therefore the baseband output passes through Q68 to amplifiers Q53 and Q52 and then to pin 19 of SK4 (i.e. the DECODER SCART).

If "Clamped" is selected for the Decoder Output at the External AV Menu, then the control line CLAMPED_DEC_VID from pin 15 of U17 goes high, which causes Q69 to switch on and rebias the base of Q68 to 0 V. When this happens, the base of Q67 is at a higher level than the base of Q68, so that the clamped video signal from the energy dispersal clamp (i.e. from the junction of R282 and R362 - see later description) is able to pass via Q95 and Q67 and from there to the amplifiers Q53 and Q52. Therefore if "Clamped" is selected, it is the clamped video signal, rather than video from the baseband amplifier in U16, which passes to the DECODER SCART.

RTL4 decoders require the PAL video option. The receiver is also compatible with Canal + and Premiere decoders, which need the clamped video signal option.

Video Processing within U16

In the second path, the signal at pin 2 of U16 is PAL de-emphasised by the circuit R302, R301, C222 and C291 and then re-enters U16 at pin 4. The main video amplifier re-inverts the signal which passes out of U16 at pin 6. It then goes back in at pin 7 where it forms one of three possible video inputs to the video source selection switch. Note that currently there is no source selection at this switch because pins 8 and 9 are not connected to anything, although there is provision to have an input at pin 8 from pin 20 of the TV SCART via a wire between W1A and W1B.

The video signal is fed from this switch to a non-inverting contrast amplifier within U16 which can be varied under control from U4 (i.e. settings made at the Picture Menu). The output from this amplifier at pin 20 of U16 is then filtered. Note that because the video input from the DECODER SCART does not enter U16, the contrast of programmes decoded by an external decoder is not affected by contrast adjustments made at the Picture Menu.

Video Filter and Phase Compensation

After the video signal has been amplified in U16, it is coupled to a low pass filter comprising L30, L31, C194, C195, C196, C197 and C198 which has a cut-off point of 5.0 MHz. Q40, C200 and associated components provide phase compensation for the delay which occurs between the chroma (colour, higher frequency) signal and the luma (outline, lower frequency) signal.

Amplifier and Sound Trap

After being filtered and phase-compensated the video signal passes through an amplifier and sound trap (Q41, Q42, L32 and associated components) to remove any residual audio sub-carriers. It then passes to the energy dispersal clamp.

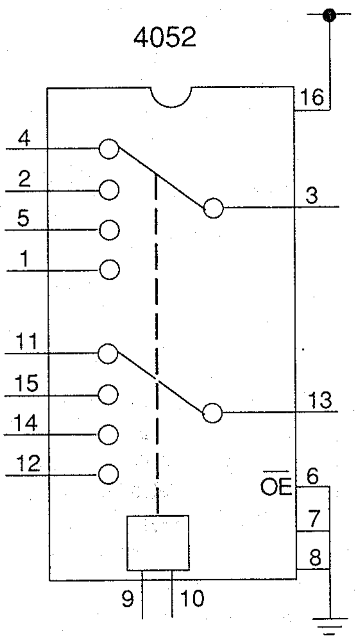
Energy Dispersal Clamp

Almost all satellite transmissions are transmitted with energy dispersal to distribute the transmitted energy more evenly across the transmission bandwidth. Energy dispersal is a triangular 25 Hz waveform added to the signal. If this is not removed, a flickering can be seen on the screen.

To remove the energy dispersal 25 Hz triangular modulation, the video signal (which is AC coupled by C205) is sync. tip clamped by Q44 and Q45. The clamp reference is set by the signal CLMP_REF (which comes from the VideoCrypt circuitry) operating through Q46, R276 and R275 on the base of Q45. If the voltage level of the signal at the junction of L33 and C205 (i.e. test point for Oscillogram 4) is 0.6 V (or more) below the voltage level at the base of Q45, this begins to conduct. As Q45 turns on, Q44 starts to conduct thereby charging up C205 until Q45 stops conducting.

The clamped video signal passes via Q47 and Q48 (which provide temperature compensation to maintain the DC level) to pin 12 of U21A and also to Q95 (see section on baseband amplification above). The clamped video at the junction of L33 and C205 also passes, via Q94, into the VideoCrypt circuitry; Q94 is a buffer which prevents 14 MHz feedback from the VideoCrypt circuitry.

Decoder Selector Switch



U21 is a 4052 switch, a diagram of which is shown right. It is controlled by both lines at pins 9 and 10, so a truth table is given below the diagram to show how connections made within the switch are controlled by the status of these lines. U21 is split into U21A and U21B.

At U21A, pins 11 and 15 are connected together and are the input from pin 20 of the DECODER SCART (i.e. the **external** video input). This input is labelled EXT_DEC in the circuit diagram and is biased to mid-rail by R42 and R43. The truth table shows that whenever pin 9 of U21A is high, this external input will be switched through to pin 13 of U21A. Pin 9 is controlled by the line INT/EXT VIDEO from pin 4 of the audio processor U14, which in turn has received information from the main microprocessor U4 about the status of the DEC_STAT line (pin 8 of the DECODER SCART). As the external video signal is also fed to pins 2 and 4 of U21B (which are connected together), when pin 9 is high the external video is also switched through to pin 3 of U21B (and from there to the sync. separator).

Whenever pin 9 of U21 is low, either pin 12 or pin 14 of U21A becomes connected to pin 13. Pin 12 is the video directly from the energy dispersal clamp; pin 14 is the video from the internal VideoCrypt decoder (i.e. both are **internal** video inputs). These pins are under the control of the VC_STATUS line, as described in the next section.

pin 9	pin 10	connections
high	high	3 to 4, 13 to 11
high	low	3 to 2, 13 to 15
low	high	3 to 5, 13 to 14
low	low	3 to 1, 13 to 12

Sync. Separator

The video signal which passes via Q94 into the VideoCrypt circuitry (see description on the separate sheet) is switched through U21B provided that pin 9 of U21 is low (i.e. internal video is selected). It is then buffered by Q16 and AC coupled by C108 into pin 19 of U12, the sync. separator. U12 has a phase locked loop with a free-running VCO which uses the ceramic resonator X3; if not locked, this will generate free-running horizontal (HSYNC) and vertical (VSY) sync. pulses.

If a valid video signal is detected at pin 19 of U12 the following happen:

- the horizontal and vertical sync. pulses are locked to the video;
- the line ID_HSYNC emerging at pin 7 of U12 is a "station ID" line which goes high to 12 V (subsequently divided down to 5 V by R155 and R159) to show that the receiver has locked onto a signal (this line also controls other functions in the video circuitry - see the descriptions which follow).

The horizontal and vertical sync. pulses (on pins 12 and 15 respectively of U12) are needed for the VideoCrypt functions and are also fed to pins 18 and 19 respectively of U17, the colour graphics generator (see below).

At U21A, switching is under the control of the VC_STATUS line from pin 4 of U9 in the VideoCrypt circuitry (inverted by Q72). Non-scrambled signals are switched through from pin 12 to pin 13 (when VC_STATUS is low), whereas descrambled signals emerging from the VideoCrypt circuitry are switched through from pin 14 to pin 13 (when VC_STATUS is high). The VC_STATUS line also goes from U9, via switch U5 (see page 23 for further details on U5), to pin 31 of the main microprocessor U4 where it is used, together with other information, for card reader selection, if more than one card reader is fitted.

As an aid to trouble shooting, you can force all the signals to pass through the VideoCrypt path by grounding test point TP1 (i.e. the base of Q72).

Circuitry between the Decoder Selector and the Graphics Generator

The selected video output at pin 13 of U21A passes through Q50 and Q49, which form an amplifier with a gain of approximately 3. The signal is then AC coupled by C216 and clamped again by Q79 to give a sync. pulse bottom voltage of approximately 1.4 V, as required by the graphics generator IC U17, where the video signal enters at pin 10.

The video signal to the VCR SCART feeds off at the junction of C216 and Q79 so that any on-screen graphics (e.g. the word MUTE) are not recorded. At this point the video signal is nominally 2 V peak-to-peak. It is buffered by Q51 which drives the output pin (19) of the VCR SCART. Note that video to a UHF-connected VCR can contain on-screen graphics which **will be recorded**.

Colour Graphics Generator

This is U17 and associated components; it is used to generate the menu background colour and on-screen text characters, under control from the microprocessor U4. There is a choice of eight menu background colours, chosen at the Picture Menu. There are three graphics modes: plain background, superimposed on a programme and superimposed on noise.

There are two oscillators associated with U17. The first oscillator is the crystal X6 which generates a frequency of 17.734 MHz. This is exactly 4 times the frequency of the colour information which is used to generate the background colour(s) and is therefore relevant to plain background mode. If this frequency is not within a few hundred hertz of 17.734 MHz, there may be no colour to the on-screen graphics display (it depends on the tolerance of the TV set). The second oscillator is within U17 and it runs at approximately 7 MHz, its frequency being set by external components L16, C127 and C207. This is used, together with horizontal and vertical sync. pulses, to generate the characters and their positions on the screen. For the superimposed on picture mode the horizontal and vertical sync. pulses come from U12 and enter U17 at pins 18 and 19 respectively. For plain background mode the horizontal and vertical sync. pulses are generated within U17. For both these modes, the white level for the characters is generated by resistors R284 and R528 on pin 9.

The video signal which enters U17 at pin 10 therefore emerges at pin 8 with any superimposed graphics such as menus, programme status information etc. The signal is then AC coupled by C261 and rebiased to approx. 5 V by R465. The video output from U17 is also fed to Q91 which extracts sync. pulses; this is used when graphics are required on noise (see below).

The rebiased video signal at the junction of C261 and R465 is buffered by Q63 and is divided by 2 by R353 and R354 to give a nominal 1 V peak-to-peak video signal, which is then fed via C244 to the source select switch U20.

For a valid video signal, the ID_HSYNC line from pin 7 of U12 is high and U4 generally commands U17 to superimpose graphics onto a picture for the Tuning Menu (and similar menus). However, if you press the TV/SAT key while the menu is displayed, U4 commands U17 to insert a plain coloured background instead of the picture (see also page 11).

Note that part of U17 is also used as a port expander for U4.

On-screen Graphics without a Valid Video Signal

When there is no valid video signal, the ID_HSYNC line from pin 7 of U12 is low and the microprocessor U4 is informed (pin 39). Generally, if the line is low, U4 sends a message to U17 via the data bus to switch in a plain screen with the words "NO SIGNAL" on it. However, if you have pressed "F, STORE" (see page 11), this plain screen is cancelled and noise can be seen as described below.

U4 sets U17 to a "black background" mode, which is similar to the plain coloured background mode. In this black background mode, U17 generates its own sync. pulses and outputs a video signal on pin 8. The sync. pulses are extracted from this video signal by Q91, which operates in a self-biasing high-gain amplifier mode. The sync. pulses are then coupled to Q92 via D58 (which is a DC shifter). Q92 is enabled by the line GR_ON_NOISE (from pin 14 of U17) being low.

The video signal (noise in this case), which is labelled VCR_VID in the circuit diagram and comes from the junction of C216 and Q79, is fed onto the base of Q93 via R533 and C279. The DC level of the base of Q93 is set by R542 and R543 to a nominal 7.5 V. This causes Q63 to be reverse biased and therefore switched off, so that the noise signal is fed out to the normal video path.

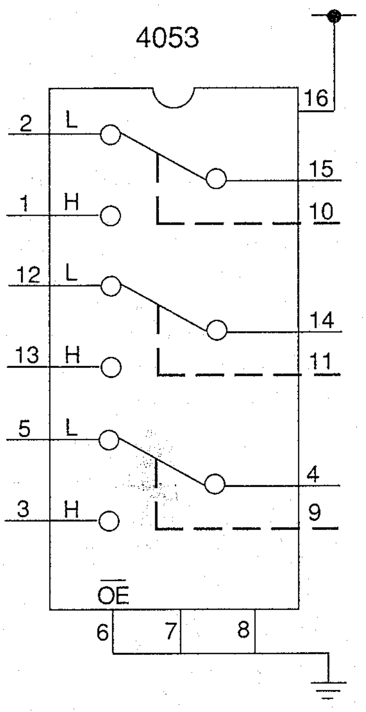
However, when a sync. pulse is extracted by Q91, it causes Q92 to switch on and therefore to rebias the base of Q93 to 0 V, which in turn switches Q93 off and allows Q63 to switch on. This enables the sync. pulse, being generated by U17, to be passed through, effectively adding the sync. pulse to the noise signal.

As explained above, Q63 is normally off during the passage of the noise signal, but the peak white graphics signal is capable of switching Q63 back on, thereby effectively adding the graphics to the noise. The white level is increased from its normal amplitude by Q90 being switched off.

When the line GR_ON_NOISE is high, Q92 is always on and Q93 always off so that the noise signal cannot progress to the normal video path towards U20.

Video Source Selection and SVHS Chroma Switch

The source selection switch is U20. This is a 4053 switch, a diagram of which, showing the switch positions and control lines, is given right. R361, R360 and C247 provide common bias voltages for the satellite and VCR SCART video inputs to the switch via R358 and R359 respectively.



The satellite video signal from the emitter of Q63 is at pin 1 of U20 and is switched through to pin 15 if pin 10 is high. This occurs if the line VCR/SAT from pin 5 of the audio processor IC U14 is low (as it is inverted by Q62, which also acts as a level converter to convert signals at 5 V to 14 V). As pins 9 and 10 of U20 are connected together, if pin 10 is high so is pin 9 and therefore the input on pin 3 of U20 is switched through to pin 4. In this case the "red in" at pin 15 of the decoder SCART SK4 is connected to pin 15 of the TV SCART, via Q66.

If pins 10 and 9 of U20 are low then the video input at pin 2 of U20 (which comes from pin 20 of the VCR SCART) is switched through to pin 15 of U20, and pin 15 of the VCR SCART (SVHS Chroma) is switched through, via pins 5 and 4 of U20, to pin 15 of the TV SCART. This means that video cassettes recorded on an SVHS VCR play correctly and the improved quality which SVHS gives is not lost.

The output at pin 15 of U20 passes via amplifiers Q61 and Q60 and is DC coupled to pin 19 of the TV SCART via R341.

It is the main microprocessor U4 which determines whether the VCR/SAT line is high or low. U4 reads the line VCR_STAT which comes from pin 8 of the VCR SCART and enters U4 via switch U5 (see page 23 for further details on U5); this line goes high when the VCR is set to play (as opposed to record). U4 can act on this information and switch the VCR signals through to the TV by means of the VCR/SAT line. U4 only looks for a change of status in the VCR_STAT line and may set the TV_STAT line to follow VCR_STAT (although depending on other factors it may not always do this).

Output to the Modulator and Optional AV Sockets

The video at the collector of Q60 (labelled TVVID in the circuit diagram) also passes via a sound trap comprising L38, C245 and C246 to the UHF modulator. It also passes via R475 to pin 2 of SK6, which is the video output of the AV phono sockets which are fitted on some models of the receiver.

Note that because this video to the modulator is fed off from a point by the TV SCART, it can contain on-screen graphics which will be recorded if a VCR is connected to the receiver by a UHF lead. (Video to the VCR SCART cannot contain on-screen graphics, as described on page 17).

RGB Disable Switch

Pins 12, 13 and 14 of U20, are used to enable/disable the RGB status line of the TV SCART (pin 16). These pins are controlled by the line 16-INHIBIT which is fed via inverter and level converter Q71 to pin 11 of U20. 16-INHIBIT comes from pin 6 of port expander U26 and is high (i.e. pin 11 of U20 is low) when menus are displayed and when the VCR is playing. When pin 11 is low, pins 12 and 14 of U20 are connected together so that pin 16 of the TV SCART, driven by emitter follower Q57, is grounded and RGB is disabled.

When pin 11 of U20 is high, pins 13 and 14 are connected together so that pin 16 of the DECODER SCART and pin 16 of the TV SCART are connected and the status of pin 16 of the DECODER SCART is therefore copied to pin 16 of the TV SCART.

In practical terms, RGB from the DECODER SCART (pins 15, 11 and 7 respectively) are present at the TV SCART (note the switching of red, as described above), but can only be used by the TV if the RGB status line on pin 16 goes high (for example if a video source is connected to the DECODER SCART).

Relay Driver

The receiver can be used to drive auxiliary relays if required because pin 10 of the DECODER SCART can be set to 14 V if required. This is enabled by setting the "Ext. Switch" option at the Tuning Menu to "On". The microprocessor U4 then sets the line REL_DRV (at pin 13 of port expander U26) high so that Q85 and, in turn, Q86 are turned on. This results in pin 10 of the DECODER SCART being connected to 14 V through R461.

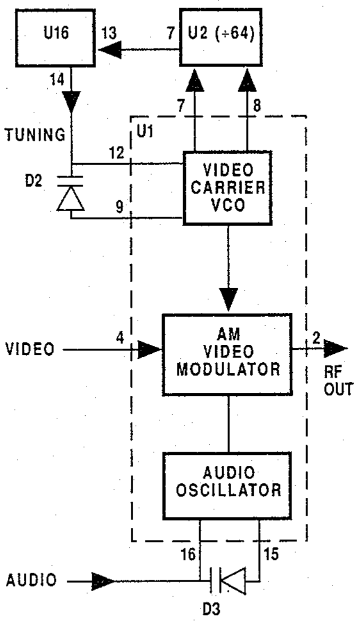
UHF MODULATOR

The RF output to the TV is generated by a frequency synthesised UHF modulator. This allows the RF output to be precisely tuned to any channel within the UHF bands IV and V (channels 21 - 69).

The circuitry consists of two main parts, a loop-through amplifier between the aerial input and the output to the TV/VCR, and the UHF modulator itself, which comprises U1, U2 and associated components. The circuitry requires two power supply inputs, one to supply the loop-through amplifier (+14 V, which is always active) and one to supply the UHF modulator itself (+5 VMOD, which is powered off in standby mode).

The heart of the modulator is the IC U1, a block diagram of which is shown adjacent. It comprises the following:

- a voltage controlled oscillator (VCO) that covers the full UHF band;
- an amplitude modulator to modulate the UHF carrier with the video;
- an audio oscillator for the sound sub-carrier;
- a video automatic gain control and clamp to ensure the correct modulation index.



The VCO within U1 is completed by the tuned circuit connected to pins 9,10,12 and 13 of U1.

Tuning is enabled by a DC tuning voltage in the range 0 to 24 V being applied to the varicap diode D2.

Differential outputs from pins 7 and 8 of U1 are fed to pins 3 and 2 respectively of prescaler IC U2, which divides the VCO frequency by 64. The output from pin 7 of U2, which should be in the range 7.1875 MHz to 13.4375 MHz, is fed into the frequency synthesis part of the UHF modulator's phase locked loop circuitry within U16 at pin 13 (see also the diagram of U16 on page 15).

The tuning voltage is derived from pulses on pin 14 of U16. They are integrated by C48, R29, Q4, Q3 and associated circuitry and eventually fed to the cathode of D2.

The audio subcarrier oscillator tuned circuit is connected across pins 15 and 16 of U1. This is set at the audio subcarrier frequency (6 MHz for PAL I; 5.5 MHz for PAL G). The audio signals from pins 25 and 26 of the audio processor U14 are combined by R222, R223, Q36 and associated components and fed to the varicap diode D3 which causes the oscillator to be frequency modulated. D3 is biased at approximately 5.6 V by Zener diode D5. Audio pre-emphasis is provided by C154 and R226 on the emitter of Q36 (which are in the audio circuitry near U14).

The video signal (labelled TVVID in the circuit diagram) passes via L38, which, together with C245, C246 and R357, forms an additional sound trap and is fed (as MOD_VID) into pin 4 of U1 via a video filter C40, L8 and C39. This is used to amplitude modulate the VCO output. The modulation index is set to be 80% by resistor R25 on pin 3 of U1.

The output from pin 2 of U1 is fed via a high pass filter (C18, L4 and C17) and a resistive pad (R19, R18 and R17) into a balun L3 which mixes the signal with the terrestrial video signals.

The loop-through amplifier comprises Q1 and Q2. Inputs from the terrestrial antenna pass through a resistive pad (R8, R6 and R7) and a 27 MHz high pass filter C4 and L2. Lightning protection is provided by D1. There is also further high pass filtering by C3, L1 and C2. RF and DC feedback are provided by R3. The output of gain stage Q1 is then fed through another resistive pad (R33, R9 and R34) to give good reverse isolation. RF and DC feedback for Q2 are provided by R10. The output from Q2 feeds the balun L3 and passes to the TV via the rear panel UHF connector. This balun prevents the remodulated satellite signals being sent to the aerial input and thereby being broadcast. Note that a high level terrestrial signal input (e.g. if an aerial amplifier is used) can attenuate the satellite signal output.

SWITCH MODE POWER SUPPLY

Mains Input and Rectification

Diodes D4, D6, D7 and D8 rectify the AC mains voltage and, together with smoothing capacitor C54, provide the DC input HT for the SMPS. C53 and T1 form a mains filter to minimise the feedback of RFI into the mains supply. Asymmetrical mains pollution is reduced by the insertion of R68 and C62 between the primary ground and the secondary chassis ground. These components are required to satisfy the mains isolation requirements and are safety-critical components (as are SK1, FS1, and T2). These components (and R49 which limits the surge current on power-up) must only be replaced by components of the correct type (see parts lists).

SMPS Controller U3

The start-up supply for U3 is obtained via R50 and R392 which charge C58 to approximately 6 V before U3 will power up. C58 sustains a charge long enough for the switch mode to reach its operating frequency. The supply for U3 is subsequently obtained from a feedback winding of the transformer T2, rectified by D11.

The frequency of the switch mode is set by R57, C55 and C64 and should be 22 to 25 kHz.

Regulation is via the feedback winding which is rectified by D12 and set by R54, R55 and R56 to give a voltage of 2.4 V at pin 8 of U3 when the supplies are at their specified voltages (5 V, 14 V etc.).

The switching transistor for the switch mode, Q5, is driven from pin 5 of U3 via R51. A negative supply, generated by D13 and limited to 4 V by Zener diode D14, is used to switch Q5 off. Excess energy from the switching of Q5 is dissipated in a snubber network R61, R60, D9, D10 and C57. Overcurrent protection is implemented by R59 and R58.

Secondary Windings of T2

The secondary windings of the transformer T2 provide the following after rectification: +5 VD1 (pin 10), +14 V (pin 8), +18 V (pin 4), and +30 V (pin 2). The LNB supply is derived from the +18 V or +14 V supply, depending on the polarisation. The tuning voltage is derived from the +30 V supply. The +8 V supply on pin 39 of U14 is derived from the +14 V supply using D37. The 12 V supply required for the sync. separator (U12) and in the VideoCrypt circuitry is produced from the +14 V supply using Q20 and associated components. The 30 V supply is reduced to a nominal 27 V by D42, to provide the 27 V (switched) voltage required by the card reader circuitry (see also about reset on page 23).

LNB Supply Switching

The LNB supply can be switched off under the control of the line LNB_OFF from pin 14 of U26 and occurs if there is an LNB short (see below). The status of the line LNB_OFF is also determined by the setting made at the "LNB Power" option at the LNB Menu (and, for dual input receivers, the setting at the "LNB" option at the Tuning Menu - i.e. the LNB_1/2 line).

The LNB supplies are switched and regulated by Q25 (and also Q24 for a dual input model). The required LNB voltage is switched to the base of these transistors which act as emitter followers. The LNBs are switched off by Q27 and Q28 being switched on, which in turn pull the base voltages of Q25 and Q24 respectively to zero. For dual input models, only one LNB is powered at any one time, the control for this being via the LNB_1/2 line which switches Q21 and Q22. These transistors are also used to switch the power to the appropriate LNB pre-amp within the tuner.

Dual input tuners require the LNB voltage for the bottom input 📡 1 (i.e. LNB 1) to be fed to pin 5 of the tuner and the voltage for the top input 📡 2 (i.e. LNB 2) to be fed to pin 3. Single input tuners require the LNB voltage to be fed to pin 5 (despite the fact that this input is labelled 📡 2).

LNB Short-Circuit Detection

The LNB current is monitored by Q29 and R208. In an overload condition such as an LNB short, the voltage developed across R208 is sufficient to switch on Q29, which in turn causes the line LNB_OVERLOAD to go high. When this occurs the LNB_OVERLOAD line informs, via U5, the main microprocessor U4 which switches off the LNB supply via the LNB_OFF line and also causes the message !!WARNING!! LNB SHORT to be displayed on the TV screen. Thereafter, the software keeps switching the LNB power on for about 10 ms and off for 2 s to check whether the short-circuit is still present.

Polarisation Switching

The setting of horizontal (H) or vertical (V) polarisation at the Tuning Menu causes the control line H/V from pin 15 of U4 to switch Q32, Q31 and Q30 in the PSU circuitry “on” or “off”. If Q30 is “on” then the LNB supply is 18 V (which is required for horizontally polarised signals). In addition, Q26 switches off thereby adding a further 5.1 V (from Zener diode D33) to the LNB reference voltage applied to the bases of Q25 and Q24. Emitter-base compensation is provided by D29 and D30 which also allow the independent switching of the LNBs.

If switch Q30 is “off” then the LNB supply is 14 V (for vertical polarisation). Q26 is switched on which prevents the voltage from D33 being added to the LNB voltage reference.

Voltage Switching for a Dual-Band LNB

If the “Dual Band LNB” option at the LNB Menu is set to “Volt”, then the H/V line controls LNB switching as described above, but the 18 V and 14 V are used to select the high and low bands respectively of a dual-band LNB. To select “Volt” at the LNB Menu, you must first set the “Positioner Pol.” option to “On”. This controls the line DISH_POS from pin 38 of microprocessor U4 to pin 12 of the DECODER SCART, so that the polarisation value (H or V) for a programme is passed to an attached dish positioner. This contains polarotor control circuitry for an electromagnetic or mechanical polarotor, which switches the polarisation.

22 kHz Oscillator and Tone Switching

Q35, Q34 and associated components form a 22 kHz oscillator which runs constantly. The 22 kHz signal from the oscillator is used as a tone which can be switched to the LNB supply by Q33, which is controlled by the line TONE from pin 16 of the main microprocessor U4. The status of the TONE line is determined by setting the “Dual Band LNB” option to “Tone” in conjunction with the “Band” setting at the Tuning Menu. Alternatively, if the “Dual Band LNB” option is not set to “Tone”, the status of the TONE line is determined by setting “On” or “Off” at the “Tone” option in the Tuning Menu.

Power Supplies During Standby

When the receiver goes into standby, the STBY line from pin 5 of port expander U26 goes low, turning transistor Q6 off which therefore means that there is no 5 V supply (+5VMOD) to the modulator itself, but the 14 V supply to the loop-through amplifier in the modulator circuitry remains, so that terrestrial signals can continue to be routed through the satellite receiver when it is in standby.

CONTROL CIRCUITRY AND DISPLAY

U4 Extension PCB

The main component in the control circuitry is U4 which is based on the Z8 microprocessor. In some receivers U4 is a custom-masked single component, but in some receivers it could be a small extension board containing a standard microprocessor and a separate ROM. This extension board contains six capacitors (C1, C2, C3, C4, C5 and C6), three ICs (U1, U3 and U4) and 16 MHz crystal X1. The circuit and component ident diagrams for this board are given adjacent; a parts list is given at the end of this manual. Note that the C3, C4, C5, C6, U1, U3 and U4 in this list are quite different from the components with those names which are on the main PCB. When the extension board is replaced by the custom-masked U4, X1, C86 and C87 on the main board are fitted.

U4 Functionality

U4 runs with a 16 MHz clock generated by crystal X1 to perform the following:

- it detects and decodes the codes received via the IR beam from the handset and those from the front panel buttons;
- it controls and sends text to the on-screen graphics IC;
- it controls the frequency synthesis loops for the tuner and UHF modulator;
- it controls the routing of the video and audio signals;
- it controls other switching functions such as the LNB supply switching;
- it activates the front panel 3-character display.

U7 is an E²PROM which is used to store information which is set at the on-screen menus. U26 is a shift register which acts as a port expander for U4. The graphics generator IC U17 also acts as a port expander for the control lines CBAND, CLAMPED_DEC_VID, GR_ON_NOISE and LNB_1/2. There are also two control lines from the audio processor U14 (IN/EXT VIDEO and VCR/SAT).

There is also port expansion at U5, a 4052 switch, which constantly “scans” the front panel buttons to see if any have been pressed and also scans the control lines at pins 2, 4 and 5. The switching is controlled by pins 9 and 10 which, as they are connected to pins 25 and 26 of U4, go high and low at the same rate as the character-scanning of the 7-segment display. Pin 12 of U5 informs U4 whether the receiver is a single or dual input model: for a single input model jumper link J7 is fitted, so that pin 12 is earthed; for a dual input model J7 is not fitted, so pin 12 is open-circuit. Pin 1 of U5 informs U4 whether the receiver is suitable for C-band: for a C-band receiver jumper link J4 is fitted, so that pin 1 is at 5 V; for a non-C-band receiver J4 is not fitted, so that pin 1 is open-circuit.

Control Lines

A block diagram of the serial bus interconnections is shown adjacent. Some of U4's control functions occur via these lines; others have specific control lines which are described at the relevant points in the circuit descriptions. Some lines (e.g. LNB_OVERLOAD, via U5) are inputs to U4 to inform it of conditions arising in the hardware. The line DEC_STAT is an input which informs U4 that pin 8 of the DECODER SCART has gone high. The line VCR_STAT is described on page 19. The TV_STAT line is always an output from U4 and is also mentioned on page 19.

Reset

A reset is applied to all the microprocessors within the unit (i.e. U4, U14 and U8 and U10 in the VideoCrypt circuitry) when the +5 V supply falls to approx. 4.75 V. Transistor Q7, which is turned on at the full 5 V, switches off when the supply drops. This switches Q8 on, which discharges the reset capacitor C83 and applies the reset to the microprocessors. If the reset line (RST) is low Q9 and Q10 also switch off; this removes the +27 V (switched) supply voltage to the card reader circuitry.

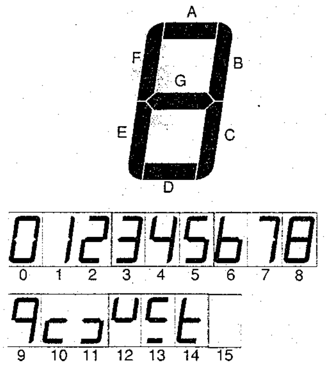
3-Character Display

Pins 25, 26 and 27 of U4 determine which of the 3 characters illuminates at any given time (although the switching is done so quickly that they appear to be illuminating simultaneously). U6 determines which of the 7 segments (A to G) in each character are illuminated. The input to pins 6, 2, 1 and 7 of U6 comes from U4 as a binary coded decimal number - see the diagrams and table right.

Example: When 35 is displayed, as seen at pin 2 of U6, there is H (for leading blank), then L (for 3), then H (for 5), so an oscillogram would show a trace which is low for one third of the period - see also Oscillogram 21 (which shows the trace at pin 2 when 1 is displayed - again it is low for one third of the period).

Pin 28 of U4 and Q14 enable the central segment of the display to be illuminated independently in standby, as this facility is not available from U6.

On the main board, there is the provision to fit four front-panel LEDs instead of the 3-character display, if this should be required in some models.



Display (BCD number)	Pin of U6			
	6	2	1	7
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

AUDIO PROCESSING

Please see the main circuit diagram and the adjacent audio block diagrams.

Demodulation, De-emphasis and Panda Noise Reduction

All of these functions are carried out by the audio processor IC U14. The baseband signal from pin 13 of the tuner is buffered by Q56 and filtered by a bandpass filter of frequency range 5 - 9 MHz (comprising Q39 and associated components). The filtered signal then enters the audio processor U14 at pin 58 and is digitised. All functions are then carried out digitally within the chip, under the control of the main microprocessor U4. The audio processor has two independent digital oscillators to tune the audio subcarriers independently.

SCART Input Selection

Audio signals from the SCART connectors enter the audio processor and are digitised for input pre-processing and so that volume, treble and bass adjustments can be carried out on them.

There is also a 7 line path which routes the incoming signals from the SCARTs directly through U14 if they require no adjustment. Note that the audio signal from the tuner is always routed through U14 via the digital path.

The following are input decoupling capacitors: C164 and C165 (for DECODER SCART), C166 and C167 (for TV SCART) and C168 and C169 (for VCR SCART). The capacitor ends connected to U14 should have a DC bias of approx. 3.8 V.

Audio Processor - Peripheral Components and Control Lines

Audio processor U14 needs various peripheral components to function correctly:

- X4, C170 and C171 (on pins 62 and 63) form the crystal oscillator circuit which runs at 18.432 MHz;
- C179, C180 (on pins 43 and 44) are filter capacitors for the SCART A/D;
- C181, C182 (on pin 42) are filter capacitors for the internal analogue voltage reference;
- C177, C178 (on pin 54) are filter capacitors for the audio baseband A/D;
- C183, C184 (on pins 40 and 38) are filter capacitors for the volume control D/A and for the AV D/A;
- C157, C156 (on pins 31 and 32) are filter capacitors for the SCART D/A;
- filter capacitors for the power supplies as follows: C175 (+5 V on pin 57), C185 (+8 V on pin 39 to 41), C148 and C149 (+5 V on pin 18 to 19), C147 (+5 V on pin 6 to 7);
- D37 and R251 form a voltage regulator to convert +14 V to 8 V at pin 39.

Control/bus links to/from the audio processor are:

- pin 9 is the I²C bus clock to pin 40 of the main control microprocessor U4;
- pin 10 is the I²C bus data which connects to pin 33 of U4;
- pin 4 is the IN/EXT_VIDEO control line to U21;
- pin 5 is the VCR/SAT control line to U20.

Audio Baseband Processing and Signal Routing

The digital field processor in U14 and the amplifiers Q36, Q37 and Q38 process all the audio baseband signals and perform signal routing.

Digital signal processing comprises:

- input pre-processing;
- audio mode selection (Stereo A, B, C or D, Mono 1 to 9, or customised mode, as selected at the Audio Menu);
- audio mode post-processing.

All of the above processing changes depend on a combination of the following:

- the operation of the TV/SAT key (for switching between satellite and terrestrial TV - pin 8 of TV SCART);
- the activity of the DEC status - pin 8 of DECODER SCART (also controlled by the 0 (AV) key for switching between the external decoder and satellite TV).

The signals emerge from pins 28 and 29 of U14 and are amplified before going to the TV SCART, the phono outputs and the optional AV sockets (see also below). The amplifiers have a gain of 4 and consist of Q37 and associated components for the right channel and Q38 and associated components for the left channel. Capacitors C265 and C266 decouple the high frequency digital noise and C173, C174 couple the signals from the audio processor U14 to the amplifiers.

DECODER SCART Audio Output

The audio source for the DECODER SCART output is always FM SAT (L and R) (frequency modulated satellite signal - i.e. analogue audio). Note that the DECODER SCART is an auxiliary input and a decoder output. It can be used as an audio and video input, but only the audio from the satellite signals and selected baseband video are output, so if you were to attach a VCR this SCART, you could record satellite audio, but you will only be able to record a good picture if the Decoder Output option at the External AV Menu is set to clamped.

C158, R228 (for right channel) and C159, R229 (for left channel) couple the output signals from pins 33 and 34 respectively of the audio processor U14 to the DECODER SCART connector. The signal level cannot be controlled by the volume rocker key on the satellite receiver handset.

VCR SCART Audio Output

The audio source for the VCR SCART output can be any one of the following:

- FM SAT (L and R)
- DEC (L and R) (audio from equipment connected to the DECODER SCART).

C162, R236 (for right channel) and C163, R237 (for left) couple the signals from pins 36 and 37 respectively of the audio processor U14 to the VCR SCART.

UHF Audio Output

The audio source for the UHF output can be any one of the following:

- FM SAT;
- VCR (audio from VCR);
- DEC.

Note that there is also provision in the hardware for audio from terrestrial TV to be the source for the UHF audio output, but this is not currently implemented in the software.

The signals going to the modulator are combined and pre-emphasised by Q36 and associated components to give a mono signal. The audio source for the modulator is always the same as that for the TV SCART. The output level can be controlled by the volume rocker key on the satellite receiver handset.

NOTE: *There is no treble/bass control for the output to the UHF modulator, therefore if the TV is connected by a UHF lead, no sound shapes can be selected.*

TV SCART Audio Output and Phono Socket Output

Any of the following audio sources can be routed to the TV SCART:

- FM SAT;
- VCR;
- DEC.

The signals to the TV SCART also pass to the right and left phono connectors SK5.

On some models additional AV phono sockets are fitted (SK6); in this case the left and right audio signals which go to the TV SCART are combined by R590 and R591 and pass to the audio socket of the AV phono sockets.

The signal level can be controlled by the volume rocker key on the satellite receiver handset.

OSCILLOGRAMS FOR FAULT TRACING

The oscillograms which follow are divided into 5 sections: Video, Audio, SMPS, Control and VideoCrypt (including some tests that can be performed with the card reader circuitry). It is important that, within each of these sections, you check the presence of the signals in the order they are given (e.g. for the video circuitry test at points 1 to 13 in that order).

The oscillograms are numbered sequentially and the appropriate section is given above each. The oscillogram numbers are marked on the circuit diagram and the PCB component ident diagram. The oscillogram test points have been chosen to be on the more convenient side of the board (i.e. non-copper side). If possible, the other points where we suggest you make checks are also on this side of the PCB.

Alongside each oscillogram is a note of where the test point is, a brief description (including any special instructions) and notes on which components you need to check if your oscillogram is not like that shown.

NOTE: The horizontal and vertical scales of each oscillogram are shown at the bottom. The 0 V point is shown by "1" with an arrow at the left-hand side; the trigger voltage is given at the bottom right-hand side and shown by an arrow at the extreme right of the trace. If the oscilloscope needs to be AC-coupled this fact is mentioned in the text, otherwise it is DC-coupled.

Generally, if you suspect that an IC is not functioning, before you try to replace it you should check the following:

- that it is receiving its supply at the appropriate pin (if it is not being supplied, trace back the supply line to the PSU to find where there is a fault);
- that the IC is receiving instructions from the microprocessor U4 or port expanders via the control lines at the appropriate pins;
- that the receiver has been configured correctly at the appropriate menus (see pages 7 to 11 and also the User Manual for details).

As stated at the top of page 33, there are several ICs within the VideoCrypt circuitry that you are not allowed to replace. If you suspect faults in this area, you must return the receiver to the Pace service centre.

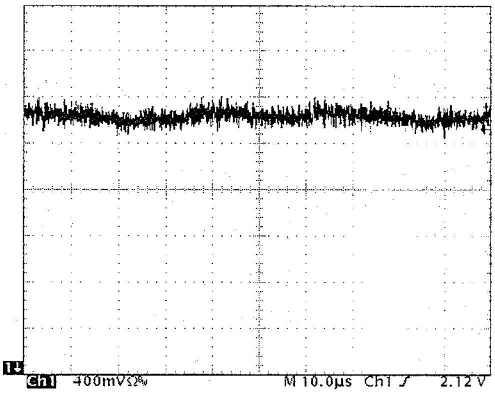
Test Point 1: Negative side of C238

Description: The trace shows tuner output (i.e. totally unfiltered video). The signal may look noisier than the trace shown if the signal is weak or the dish antenna is small.

If the trace is not as shown, check:

- that the tuning voltage on pin 15 of TUNER1 changes when different programmes are selected;
- the prescaler output on pin 18 of TUNER1;
- the 4 MHz reference at pin 12 of U16;
- the LNB voltage on pin 5 or pin 3 of TUNER1 (depending on whether the current programme is from LNB 1 or LNB 2 respectively).

1. VIDEO



Test Point 2: Positive side of C199

Description: Traces 2A and 2B show the normal video signal at test point 2, only the time axis is different; there may be slight variations in the trace, depending on picture content.

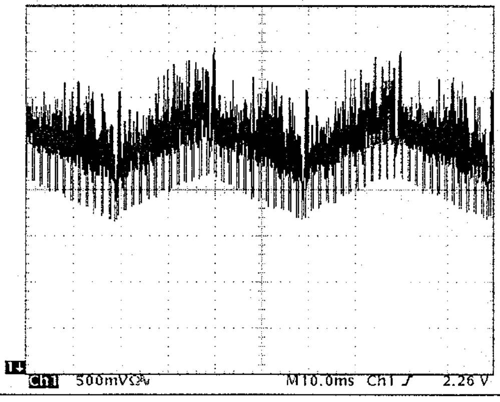
If the trace is not as shown, check:

- the route through U16, i.e. check back from pin 20 through to pin 3 of U16 to check that the trace is as shown. (Consult the circuit description for U16.)

Note that pin 3 of U16 is similar, in effect, to point 1 above.

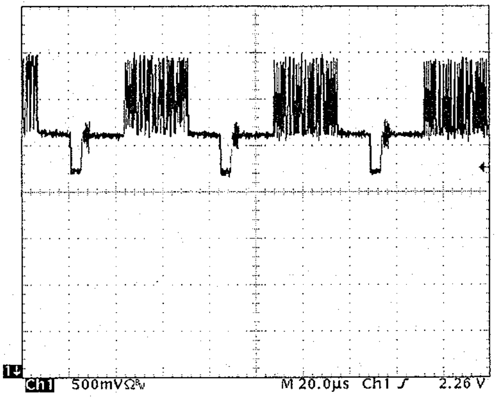
Note that pin 6 of U16 is similar, in effect, to point 1 above, but should give a trace of much larger amplitude (approx. 3 V p-p).

2A. VIDEO



Test Point 2: positive side of C199 (see also previous Oscillogram 2A)

2B. VIDEO



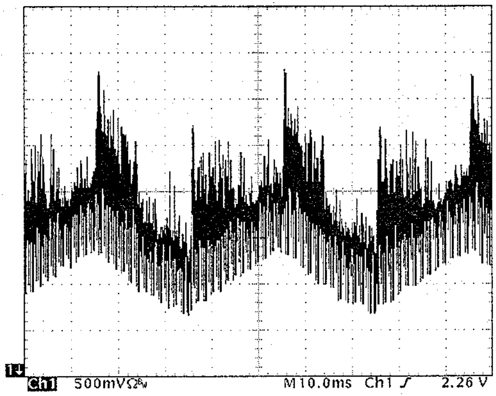
Test Point 3: Junction of L32 and R269 (most easily tested at the solder pad of the not fitted X7)

Description: The trace shows unclamped video of the correct gain. This is the video signal at one side of Q43 and C205, whereas Oscillogram 4, below, shows the signal at the other side.

If the trace is not as shown, check:

- Q40 and associated components;
- the gain stage (Q41, Q42).

3. VIDEO



Test Point 4: Junction of L33 and R272

Description: The trace shows clamped video at the correct DC level of 2.6 V (black level). This is the video signal at the opposite side of Q43 and C205 (compared with Oscillogram 3).

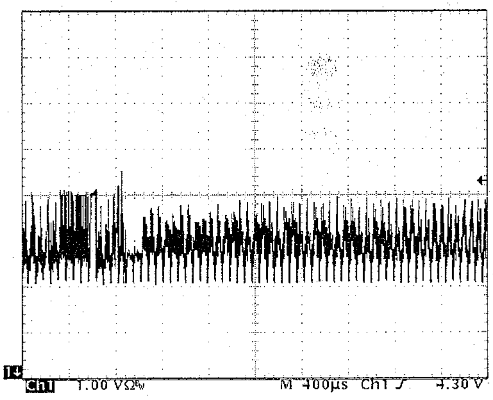
If the trace is not at the correct DC level, check:

- that the DC level at the base of Q45 (i.e. at the positive side of C206) is correct (2.6 V) - if it is, then Q45 and/or Q44 may be faulty.

If the trace is not as shown, but looks like Oscillogram 3:

- Q43, Q45 and/or Q44 may be faulty.

4. VIDEO



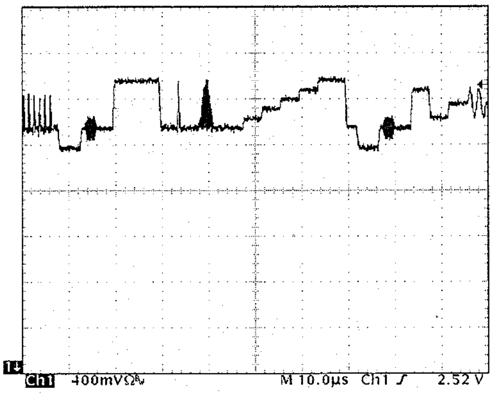
Test Point 5: LK237

Description: This trace also shows clamped video; its DC level is important - it should be approx. 2 V black level and approx. 600 mV peak-peak (sync. to bar).

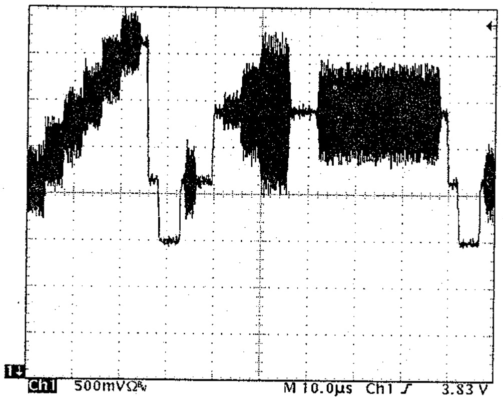
If the DC level is not correct, check:

- Q48, Q46, Q45, Q44 and their associated circuitry.

5. VIDEO



6A. VIDEO



Test Point 6: Negative side of C261 (same as pin 8 of U17)

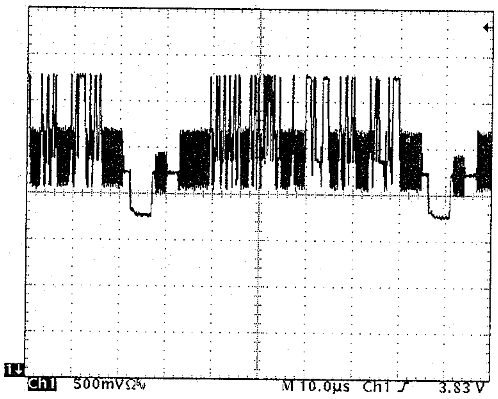
Description: Trace 6A shows the trace you would expect at test point 6 when there is a picture on the screen; trace 6B (next oscillogram) shows what to expect if there is a plain coloured background with graphics on the screen.

Check for trace 6A. If this is as expected, then select a plain coloured screen with graphics (e.g. Main Menu) and look for trace 6B.

If the traces are not as shown, check:

- that the horizontal sync is being fed into pin 18 of U17 (see oscillogram 10);
- that the vertical sync is being fed into pin 19 of U17 (see oscillogram 11).

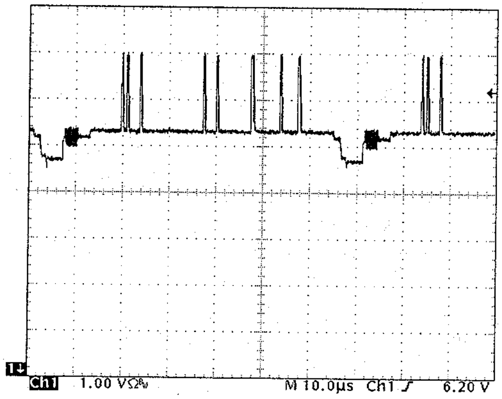
6B. VIDEO



Test Point 6: Negative side of C261 (same as pin 8 of U17) (see oscillogram 6A)

Description: Trace 6B shows what to expect at test point 6 if there is a plain coloured background with graphics on the screen. The graphics can be seen on the centre of the trace.

7. VIDEO



Test Point 7: Positive side of C261

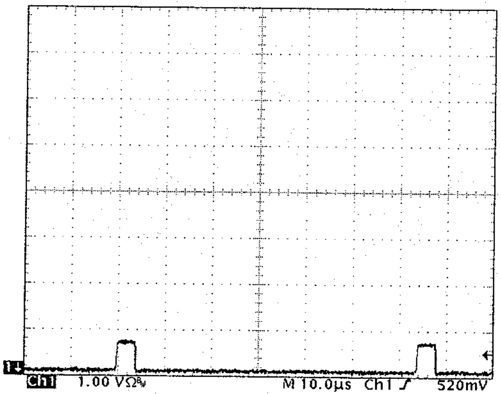
Description: The trace shows the sync. pulses and graphics when U17 is in "black background" mode (i.e. it is generating its own sync. pulses on a video signal from pin 8 of U17).

To set up this "black background" mode, display the Tuning Menu for the current programme, then pull out the appropriate LNB connector.

If the trace is not as shown, check:

- Q91, Q92, Q93, Q63 and associated components.

8. VIDEO



Test Point 8: Negative side of D58

Description: The trace shows the sync. pulses which have been extracted by Q91 (again when U17 is in black background mode).

If the trace is not as shown, check:

- Q91, D58 and associated components in the sync. extractor circuitry

Test Point 9: Link J8

Description: The trace shows the graphics on noise (again when U17 is in black background mode)

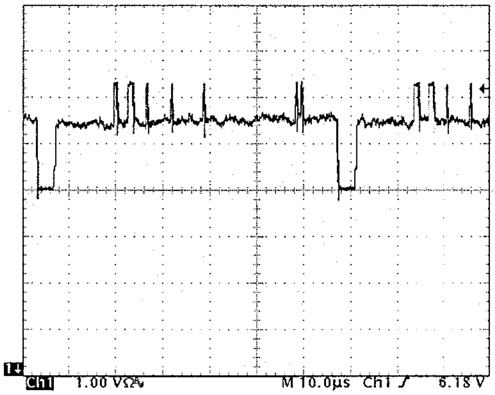
If the trace does not show sync. pulses, check:

- Q92, Q93, Q63 and associated components.

If the trace does not show graphics, check:

- Q90, Q63 and associated components.

9. VIDEO



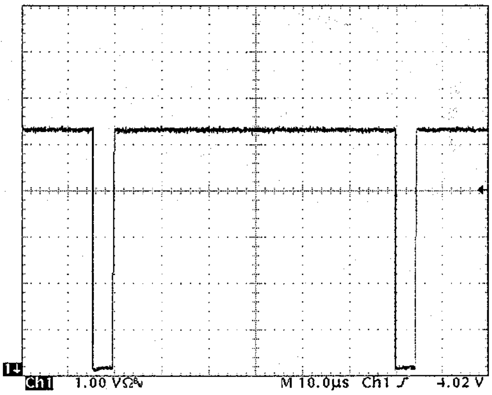
Test Point 10: LK178

Description: The trace shows the horizontal sync. as it enters pin 18 of U17.

If the trace is not as shown, check:

- U12, Q17 and associated components in the sync. separator circuitry

10. VIDEO



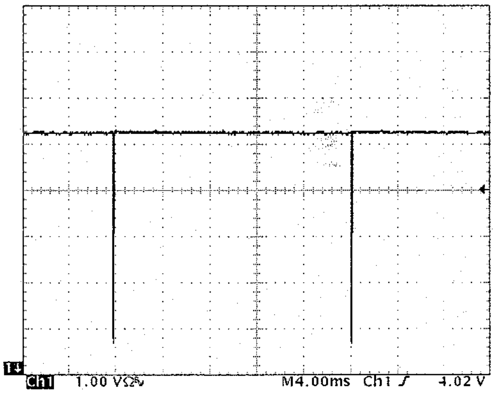
Test Point 11: LK177

Description: The trace shows the vertical sync. as it enters pin 19 of U17.

If the trace is not as shown, check:

- U12 and associated components in the sync. separator circuitry

11. VIDEO



Test Point 12: Pin 19 of SK3 (TV SCART)

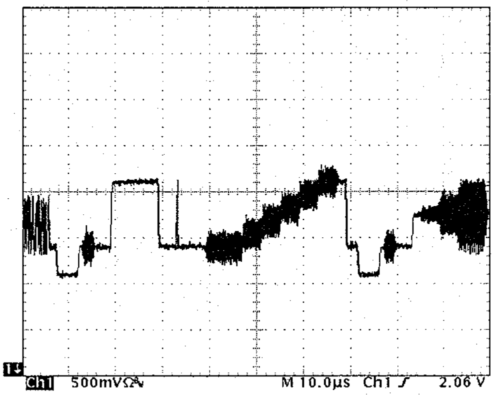
Description: The trace shows approx. 1 V peak-to-peak of clamped composite video (if the TV is connected to the SCART socket).

If the trace is not as shown or has the wrong amplitude, check:

- Q60, Q61 and associated circuitry.

Note that the video output to the TV SCART at test point 12 depends on the routing through switch U20 to pin 15 of U20. For the satellite video signal pin 1 should be switched to pin 15 (see the video circuit description on page 19).

12. VIDEO



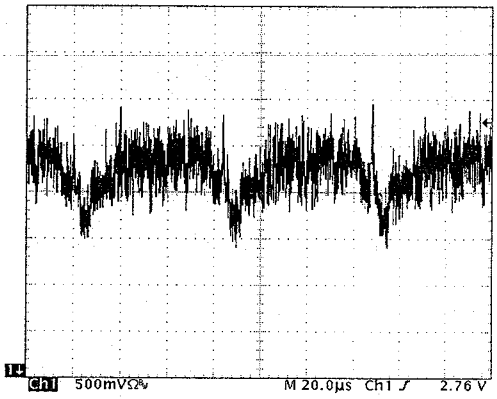
Test Point 13: LK249 which is the same as pin 19 of SK4 (DECODER SCART)

Description: The trace 13A is when PAL has been set at the "Decoder Output" option in the Decoder Menu. It shows baseband video and should be approx. 2 V peak-to-peak. See also Oscillogram 13B below.

If the trace is not as shown or has the wrong amplitude, check:

- U16, R303, R304, C223, C224 and the route from pin 22 of U16 (Q68, Q53, Q52 and associated circuitry).

13A. VIDEO



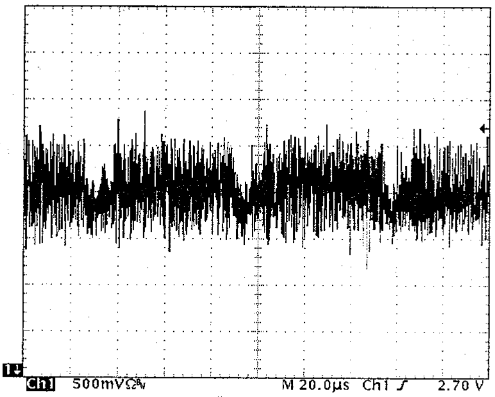
Test Point 13: LK249 which is the same as pin 19 of SK4 (DECODER SCART)

Description: The trace 13B is when MAC has been set at the "Decoder Output" option in the Decoder Menu. It shows baseband video and should be approx. 1 V peak-to-peak. See also Oscillogram 13A above.

If the trace is not as shown or has the wrong amplitude, check:

- U16, R305, C225 and the route from pin 22 of U16 (Q68, Q53, Q52 and associated circuitry).

13B. VIDEO



Test Point 13: LK249 which is the same as pin 19 of SK4 (DECODER SCART)

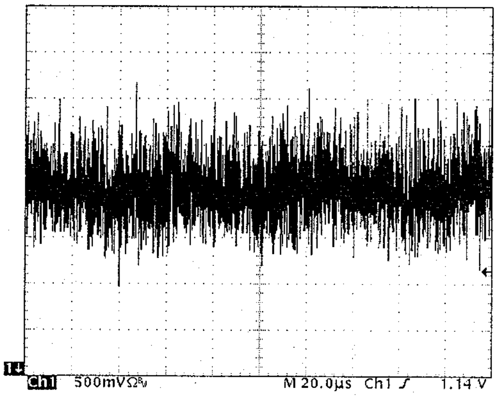
Description: The trace 13C is when "Flat" has been set at the "Decoder Output" option in the Decoder Menu. It shows baseband video and should be approx. 2 V peak-to-peak.

If the trace is not as shown or has the wrong amplitude, check:

- U16 and the route from pin 22 of U16 (Q68, Q53, Q52 and associated circuitry).

Note that when "Flat" is selected, the output from the pre-amp within U16 is switched straight through to the baseband amplifier, therefore bypassing all the de-emphasis circuitry.

13C. VIDEO



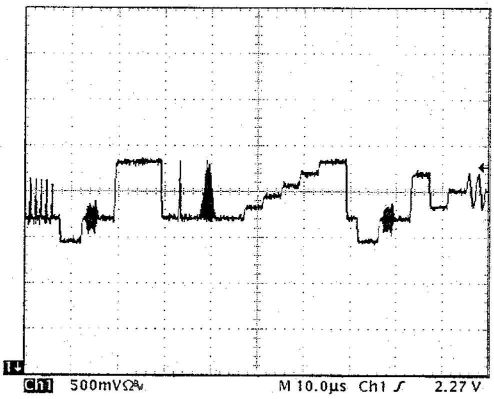
Test Point 13: LK249 which is the same as pin 19 of SK4 (DECODER SCART)

Description: The trace 13D is when "Clamped" has been set at the "Decoder Output" option in the Decoder Menu. In this case, it is NOT the output from the baseband amplifier in U16 which passes to the DECODER SCART. Instead it is the clamped video signal from the energy dispersal clamp. The trace is therefore very similar to Oscillogram 12.

If the trace is not as shown check:

- Q95, Q67, Q53, Q52 and associated circuitry.

13D. VIDEO



Test Point 14: Pin 63 of U14

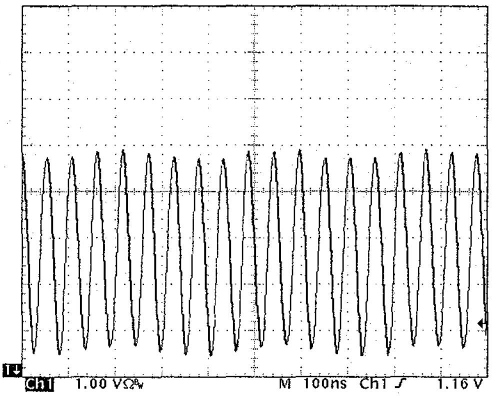
Description: The oscilloscope probe should be on x 10, otherwise it will load the crystal.

The trace shows the amplitude of the 18.432 MHz reference.

If the trace is not as shown, check:

- X4 and associated circuitry.

14. AUDIO



Test Points 15: Positive sides of C160 and C161 and at LK289

Description: AC coupled oscilloscope

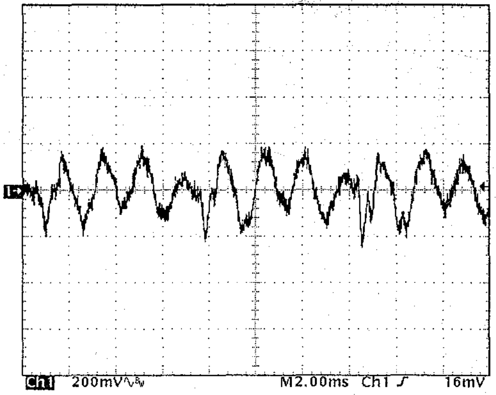
The trace should be similar at all three points. It shows the amplified audio signals for the right channel (C160) and left (C161) before they pass to the phono outputs and to the TV SCART. At LK289 the signal is the mono output to the UHF modulator (i.e. the left and right channels combined and pre-emphasised by Q36).

The signal should be biased around 0 V, so ensure that the trace is produced with 0 V at the centre of the screen.

If the trace is not as shown, check:

- the components and circuitry back to and including U14.

15. AUDIO



WARNING: While you are making the following measurement, you must NOT be earthed and the oscilloscope must NOT be earthed at its mains plug. The oscilloscope probe's earth clip must be attached to the junction of R68 and C61. Do not touch any metal parts of the oscilloscope.

Test Point 16: End of R51 (i.e. same as U3, pin 5)

Description: AC coupled oscilloscope

The frequency of the trace varies with the input voltage and the PSU load.

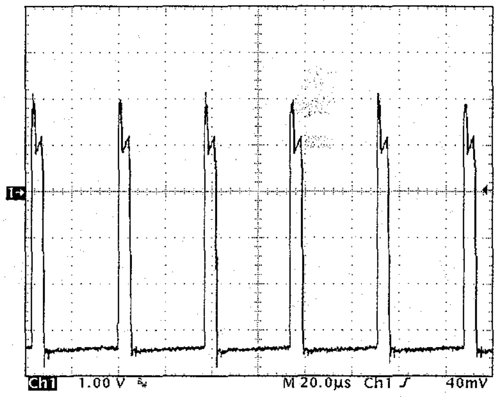
If trace is not as shown, TURN OFF THE PSU and check:

- the SMPS circuit; if fuse FS1 keeps blowing, check for shorts on any of the supply rails and that Q5 is not short-circuit.

Taking heed of the WARNING above, power up the receiver again and check that:

- the voltage at positive side of C58 (i.e. same as pin 6 of U3) charges up to approx. 6 V then drops to approx. 5.5 V - if it does not, check FS1 or suspect U3.

16. SMPS



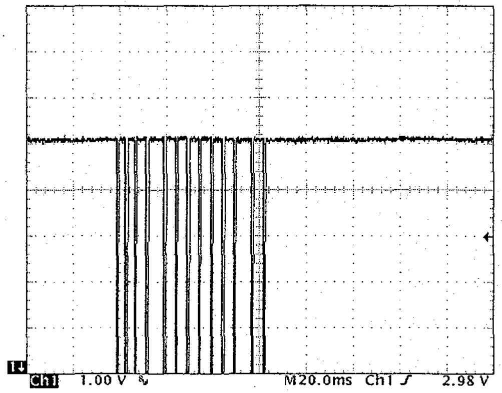
Test Point 17: Pin 2 of IR1

Description: The trace shows typical data out of the IR sensor; press keys on the handset to obtain the trace.

If the trace is not as shown, check:

- the handset and IR1.

17. CONTROL



Test Point 18: Pin 33 of U4

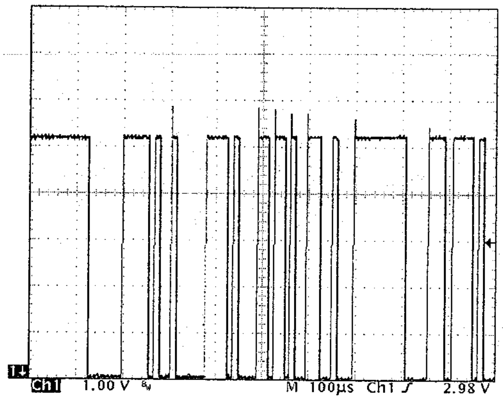
Description: The trace shows a typical data (DATA) signal when the handset keys are pressed to change the programme number.

Press the number keys while looking for the trace.

If the trace is not as shown, check:

- U4 and any of the ICs on the I²C bus or serial bus.

18. CONTROL



Test Point 19: Pin 29 of U4

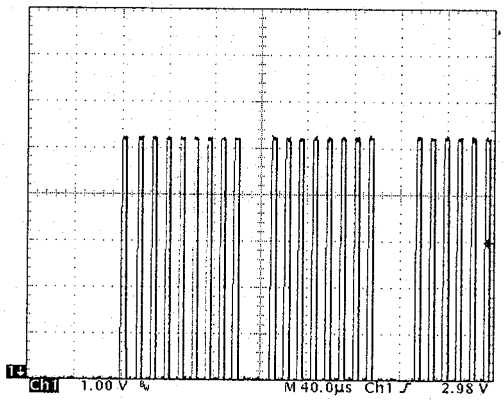
Description: The trace shows a typical serial clock (SERIAL_CLK) signal when the handset keys are pressed to change the programme number. The I2C_CLK line on pin 40 of U4 should be similar.

Press the number keys while looking for the trace.

If the trace is not as shown, check:

- U4 and any of the ICs on the serial bus (for SERIAL_CLK) or the I²C bus (for I2C_CLK).

19. CONTROL



Test Point 20: LK54 (i.e. pin 13 of U5 and pin 32 of U4)

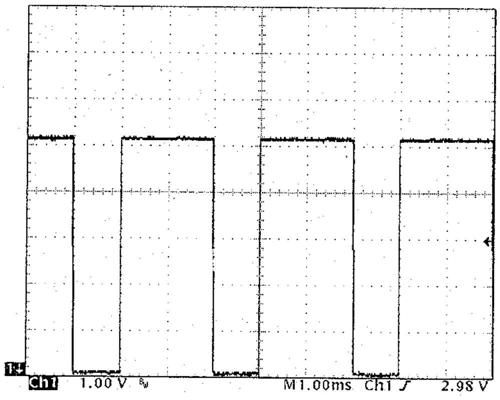
Description: The trace shows the functioning of U5. The signal should be logic 1 until one of the three front panel buttons ⏻, + and – (switches SW1, SW2, SW3 respectively) is pressed. When one button is pressed, the trace has a logic 0 for one third of the total period (as shown right). When two buttons are pressed, the logic 0 is for two thirds of the period and when all three buttons are pressed, the whole trace is logic 0.

If you test at pin 3 of U5 (pin 31 of U4) the trace should be similar, except the normal state is logic 0. The simplest way to test this is to short out the LNB to simulate LNB overload conditions. This should give a logic 1 for one third of the period.

If the trace is not as shown, check:

- U5, switches SW1, SW2, SW3 and control lines at U5.

20. CONTROL



Test Point 21: LK55 (i.e. pin 2 of U6 and pin 23 of U4)

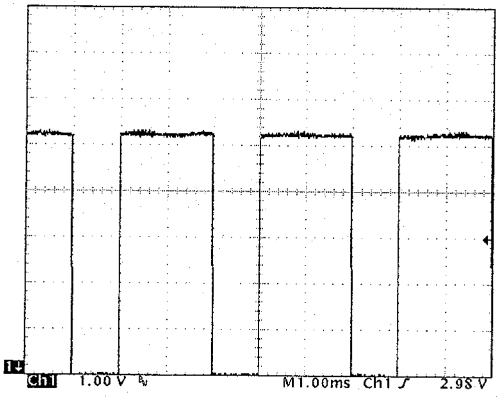
Description: The trace shows a typical control signal for the illumination of the segments (A to G) in the 3-character display. The ratio of time at logic 0 to the total period depends on which character is displayed (the trace right is for the character 1). The normal state is logic 1 (i.e. when nothing is displayed on the front panel, the trace will be constantly high).

See also the diagrams and table on page 23. For 1, the first two characters are not illuminated, the third is illuminated in segments B and C. Therefore the trace at pin 2 goes to logic 0 for one third of the period. Check that the traces obtained at pins 1, 2, 6 and 7 of U6 correspond with the tables on page 23 when various characters are displayed on the front panel.

If the trace is not as shown, check:

- U4, U6 and LED1.

21. CONTROL



NOTE: In VideoCrypt fault tracing, you are not permitted to swap out ICs U8, U9, U10, U11, U12 and U13, so if you suspect a fault in these ICs you must return the receiver to the Pace service centre.

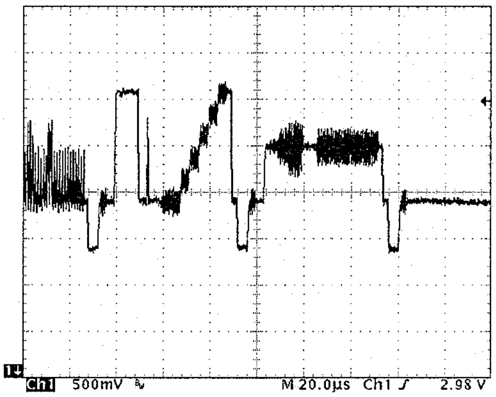
Test Point 22: Pin 14 of U8 (VideoCrypt circuit diagram)

Description: This trace shows the clamped video input to the VideoCrypt circuitry (note it is very similar to Oscillogram 5); its DC level is important - it should be approx. 2 V black level and approx. 1.85 V peak-peak (sync. to bar).

If the DC level is not as shown, check:

- Q94, Q46, Q45, Q44 and their associated circuitry.

22. VIDEOCRYPT



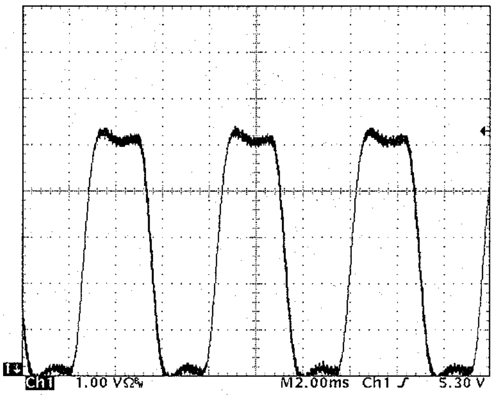
Test Point 23: Pin 36 of U8 (VideoCrypt circuit diagram)

Description: The trace shows the 7 MHz clock signal.

If the trace is not as shown, check:

- that X2 is oscillating at 28 MHz.

23. VIDEOCRYPT



Test Points 24: Pins 23, 24, 25, 26, 27, 28, 29, 30 of U8 (VideoCrypt circuit diagram)

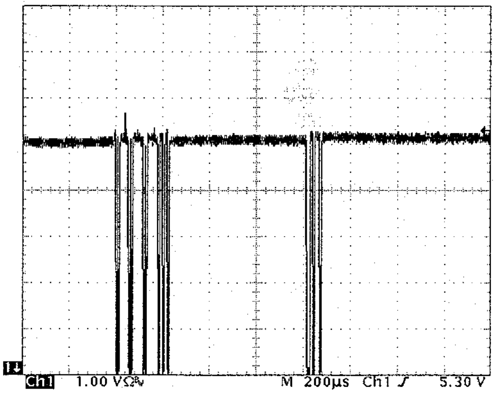
Description: The trace should look similar at all of the above test points, which are the data bus outputs of U8.

Check that all 8 bits of data are present (one bit is associated with each of the above pins). Check that the data has a similar appearance by testing at pins 14 to 21 respectively of U9, at pins 7 to 14 respectively of U10 and at pin 1 to 8 respectively of U11.

If the trace is not as shown, check:

- the appropriate IC and look for shorts or broken tracks on the data bus.

24. VIDEOCRYPT



Test Point 25: Pin 19 of U12 (VideoCrypt circuit diagram)

Description: This is the video input to the sync. separator U12. Check the DC level which should be approx. 1.8 V (black level).

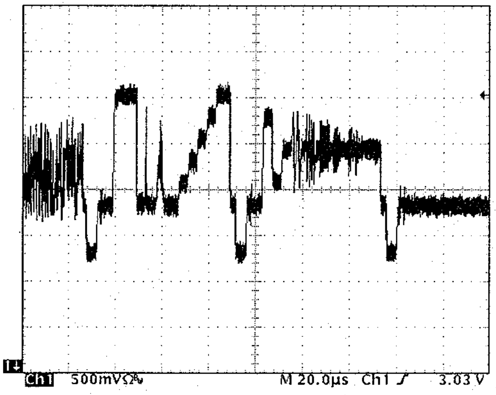
If the DC level is not 1.8 V, check:

- that the signal is AC decoupled by C108 (by checking that the voltage is different at the other side of C108).

If the trace is as shown, but there is still a problem, check:

- that the ID_HSYNC line is high (5 V) at LK84; if it is not then suspect that U12 or associated components are faulty.

25. VIDEOCRYPT



Test Point 26: Junction of L17 and X3 (VideoCrypt circuit diagram)

Description: The trace shows the 500 kHz clock signal.

If the trace is not as shown, check:

- R143 and X3

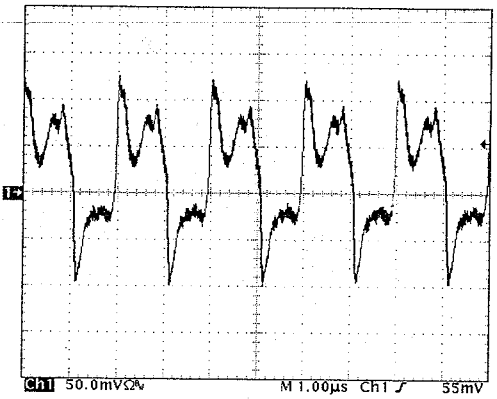
If the trace is as shown, but there is still a problem, check:

- that the reset lines (RST) are greater than 4 V at the following points: U4 pin 6 (main circuit diagram), U8 pin 20 and U10 pin 1 (VideoCrypt circuit diagram)

If any of the above reset lines are less than 4 V, check:

- Q7, Q8, Q9, Q10 and associated components.

26. VIDEOCRYPT



Test Point 27: Negative side of C216 (main circuit diagram)

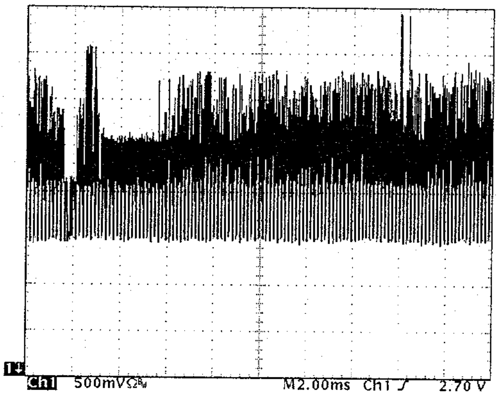
Description: The trace shows the video signal with a scale of 2 ms per division on the time axis. There are two areas of peaks. The first (leftmost) is the vertical sync. and VITS; the other is the graphics. Oscillogram 27B (see next oscillogram) is a larger scale version of the graphics portion of oscillogram 27A.

The test needs to be carried out when an encrypted programme has been chosen but the viewing card is not inserted (so that graphics messages appear on the screen). Note the voltage level of the inserted graphics.

If the voltage level is not as shown on the trace, check:

- U9, U18 (including R291, R292 and R293), Q50, Q49 and associated circuitry.

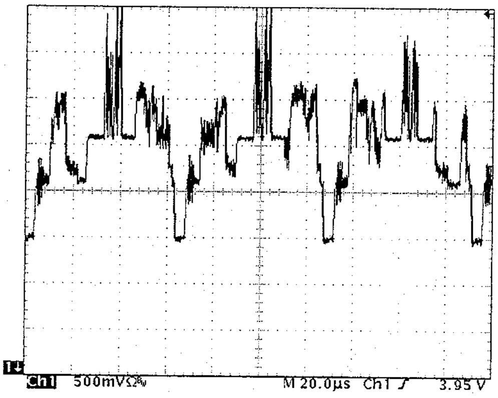
27A. VIDEOCRYPT



Test Point 27: Negative side of C216 (main circuit diagram)

Description: This is a larger scale version of the graphics portion of oscillogram 27A (see preceding oscillogram).

27B. VIDEOCRYPT



Checks on the Card Reader

If the receiver is still showing the "CARD INVALID" message, but testing at the test points 22 to 27 has given traces as shown and you appear to have found no faulty components in the VideoCrypt circuitry, you can then carry out some further checks on the card reader circuitry as described below.

Supply to the card reader IC:

- check that the 27 V (switched) supply is present at pin 3 of U13 and 12 V is at pin 7 of U13; if the 27 V is absent, check Q9 and Q10 (main circuit diagram) and that the reset line (at LK48 on the main circuit diagram) is high.

Supply to the card reader:

***NOTE:** For the first of the two tests below we recommend that you use a **dummy** card (or a SKY card upside down), because a good, valid card could be damaged if there is a problem with the levels of VCC and VPP (which could go as high as 27 V).*

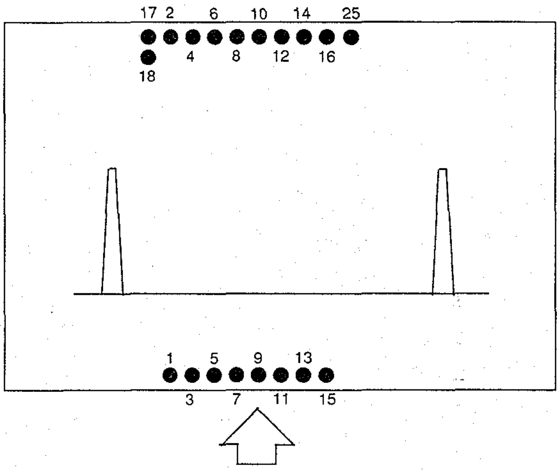
- with the **dummy card** inserted, check that VCC and VPP at pins 9 and 5 respectively of the card reader reach 5 V temporarily as the card is inserted (they do not remain at 5 V unless the card is valid); if they do not reach 5 V, check that VCC and VPP are 5 V at pins 8 and 2 respectively of U13;
- if VCC and VPP are not 5 V (or they are 5 V at U13 but there is still a problem), check the path from U13 to the card reader and also check that the card detect line (CARDDET) at pin 17 of U13 goes to 5 V when the card is inserted.

Clock to the card reader:

- check that incoming clock is present at pin 1 of U15 and the buffered clock output (approx. 3.5 MHz) is present at pin 4 of the card reader (C3CLK line). If there is a problem the clock will be intermittent.

If there is still a problem and the above signals are present, contact the Pace service centre.

Pin Numbering for Card Reader



This is the view of the pins on the **solder side** of the board (the pins are not accessible from the component side).

GRID REFS - IDENT DIAGRAMS FOR MAIN PCB

* = not fitted
† = mounted on copper (SMD) side of PCB
^ = actually a link (in an inductor position)
° = actually a capacitor (in a resistor position)
◊ = actually a zerohm link (in a capacitor position)
∞ = actually a diode (in a link position)
§ = not fitted if there is a U4 extension PCB
A = component of different pitch could be fitted

CAPACITORS

C1	C14
C2	B14†
C3	B14†
C4	B13†
C5	B14†
C6	C14†
C7	C14†
C8	C14†
C9	B14†
C10	B13†
C11	B13†
C12	C13†
C13	C13†
C14*	C13†
C15*	B14†
C16	C13†
C17	C13†
C18	C13†
C19	D13†
C20	D13†
C21	D13†
C22	D13†
C23	D13†
C24	D13†
C25	D13†
C26	D13†
C27	C13†
C28	C13†
C29	C13†
C30	C13†
C31	D13†
C32	D13†
C33	C14†
C34	C14†
C35*	D14†
C36	D14†
C37	D14†
C38	C14†
C39	C14†
C40	C14†
C41	D14†
C42	D13†
C43*	D13†
C44	E12†
C45	E12†
C46	E13†
C47	E13
C48	E13
C49	E13†
C50	E13†
C51	D14
C52	E13
C53	B2
C54	D2
C55	E2†
C56	I6
C57	F2
C57A*	G2
C58	E2
C59	E3
C60	D3
C61	D3
C62	G3
C62A*	G3
C63	D8
C64	E2†
C65	I2†
C66	I2
C67	I4
C68	I2†
C69	J2†
C70	J2
C71	I3†
C72	J2†
C73	J3
C74	I3†
C75	J3†
C76	J3
C77	I4
C78	H5
C79	D13†
C80	C10
C81	C4
C82	C10
C83	I5
C84	G5†
C85	G6
C86§	G6†
C87§	G6†
C88	K2†
C89	J6
C90	B4†
C91	F9†
C92	G9†
C93	G9†
C94	G8†
C95	H9†
C96	G10†
C97	G9†
C98	G10†
C99	G10†
C101*	J4
C102	J8
C103	I7†
C104	I7†
C105	J7
C106	I8†
C107	I8†
C108	J8†
C109	I8
C110	I8†
C111	I8†
C112	G8†
C113	G8†
C114	G8†
C115	G8†
C116	G8†
C117	I7
C118	G8
C119	G8†
C120*	G13†
C121	J7†
C122	H10
C123	G9†
C124	I8
C125*	H10
C126	H6†
C127	E8†
C128	J12†
C129	I11†
C130	I11†
C131	J12†
C132	J12†
C133	G12†
C134	G12†
C135	H4
C136	H4†
C137	D12†
C138*	B11
C139*	B12
C140	C11
C141	D12†
C142	D11
C143	J8
C144	I7†
C145	I6†
C146*	J4†
C147	E6†
C148	E5
C149	E5†
C150	E4†
C151	E4†
C152	E4†
C153	F4
C154	E4†
C155	F4
C156	E4†
C157	E4†
C158	B10
C159	B11
C160	C7
C161	C7
C162	C5
C163	C5
C164	B11†
C165	B11†
C166	C6†
C167	C6†
C168	C5†
C169	B5†
C170	D6†
C171	D6†
C172	E6†
C173	C7
C174	C7
C175	E5†
C176	E5†
C177	E5†
C178	D5
C179	E5†
C180	E4†
C181	E4†
C182	D5
C183	D4
C184	D4
C185	E4†
C186	C6
C187	C6†
C188	D6†
C189	D6†
C190	D6†
C191	D7†
C192	E6†
C193	E6†
C194	D10†
C195	C10†
C196	D10†
C197	D10†
C198	D10†
C199	D9
C200	D10†
C201	D10†
C202*	D10†
C203	D10†
C204	D10†
C205	D10
C206	E9
C207	E8†
C208	D7
C209	D8†
C210	D8†
C211	E8†
C212	E8
C213	E8†
C214	E8†
C215	E9†
C216	E9
C217	D11
C218	D11†
C219	G12†
C221	D10
C222	D11†
C223	C11†
C224	C11†
C225	D10†
C226*	H8†
C227*	H8†
C228*	H8†
C229*	H8†
C230	E9†
C231	D9
C232*	B4†

GRID REFS - IDENT DIAGRAMS FOR MAIN PCB (cont.)

C233	D10
C234	C8†
C235*	B10†
C236	B8
C237*	C11
C238	C12
C239*	C11
C240	C12
C241	B6†
C242	B5†
C243	B4
C244	C4
C245	E13†
C246	F13†
C247	C4
C248	F14†
C249	J9†
C250	G6†
C252	C10
C253	D11†
C254	D11†
C255	D11†
C256	C8
C257	I6†
C258	I7†
C259	I7†
C260	H10†
C261	D8
C262	E13
C264	E4†
C265	E4†
C266	E4†
C267◊	E6†
C268	C7
C269	B5†
C270	C4†
C271	B8†
C272*	G12
C273*	G13†
C274*	G13†
C275*	F13†
C276*	G12
C278	D9
C279	D9†
C280*	F10†
C281*	B11
C282	D12†
C283	E11†
C284	I10†
C285	G7†
C286*	E11
C287*	E10†
C288*	E10†
C289	B5
C290	B8
C291	D11†
C292	C10†
C294	C12†
C295	F13†
C296*	E11†
C297*	F10†
C298*	F10†
C299	C10†
C300	D7†
C301	F9†
C302◊	E9†
C303	C12†
C305	D12†
C306	H5†
C307◊	H5†
C308◊	E8†
C309	D10†
C310	H5†
C311*	E11†
C312*	E8†
C313	J8†
C314	G8†
C315	J9†
C316	I10†
C317	C13†

DIODES

D1	B13†
D2	D13†
D3	C13†
D4	D2
D5	E12
D6	D2
D7	D2
D8	D2
D9	G3
D10	G2
D11	F3
D12	F3
D13	C3
D14	D3
D15	I2
D16	I2
D17	I3
D18	I3
D19*	I4
D20	J8
D21	J9
D22	J8
D23	I8
D24	I8
D25	G12
D26	H13
D27	G12
D28	H13
D29	F13
D30*	F13
D31	F14
D32	F14
D33	F14
D34	F14
D35	K7
D36	K7
D37	C6
D39	B10
D40	B5
D41	C9
D42	J6
D43	C9
D44	B8
D45	B3
D46	B5
D47*	I2
D48	I11
D49	G12
D50	I11
D51	G12
D57*	G13
D58	D9
D59	E7
D60	E7
D61	D9
D62	B6

INDUCTORS

L1	B14
L2	B13
L3	B13
L4	C13
L5	D13
L6	D13
L7	D13
L8	C14
L9	I3
L10	J4
L11	H4
L12	J7
L13	G10
L14	G8
L15	G8
L16	E8
L17	J8
L18	G9
L19	G9
L20	D8
L21	E8
L24	D12
L25	J7
L26	I4
L27	I7
L28	D6
L29	E6
L30	D10
L31	C10
L32	E10
L33	E10
L34	E10
L35	F12
L38	E13
L39^	E13
L40	G6
L41	I8
L42	G12
L43	G9
L45*	G8

LINKS

J1	I4
J2	D5
J3	D6
J4*	H7
J5	C11
J6	K7
J7	H6
J8	C8
J9*	H10†
J10	H10†
J11	H10†
J12*	H10†
LK10	C8
LK18	K3
LK19	K3
LK20*	F10
LK21	J2
LK22	K4
LK23	J4
LK24	J4
LK25	J4
LK26	J4
LK27	J5
LK28	J5
LK29	I5
LK30	J5
LK31	J5
LK32	J5
LK33	J6
LK34	I4
LK35	I4
LK36	J6
LK37	I4
LK38	H5
LK39	H5
LK40	G4
LK41	K7
LK42	K6
LK43	J7
LK45	J6
LK46	I6
LK47	I6
LK48	I6
LK49	I6
LK50	I6
LK51	J7
LK52	J7
LK53	I7
LK54	I6
LK55	I5
LK56	I6
LK58	J7
LK59	J8
LK60	J8
LK61	J8
LK62	J9
LK63	J9
LK64	I9
LK65	I6
LK66	I6
LK67	H6
LK68	H6
LK69	I7
LK70	I7
LK71	H7
LK72	H7
LK73	H7
LK74	H7
LK75	H7
LK76	H7
LK77	H7
LK78	H8
LK79	H8
LK80	G6
LK81	H6
LK82	H7
LK83	H7
LK84	H7
LK85	H7
LK86	G7
LK87	G7
LK88	H8
LK89	G8
LK90	H7
LK91	G7
LK92	G7
LK93	G7
LK95	G7
LK96	I9
LK97	H9
LK98	H9
LK99	H9
LK100	J10
LK101	I10
LK102	H10
LK103	H9
LK104	H10
LK105	G9
LK106	G10
LK107	G10
LK108	G10
LK109	J11
LK110	J11
LK111	J11
LK112	J11
LK113	J11
LK114	J11
LK115	I11
LK116	I11
LK117	I11
LK118	I11
LK119	H11
LK120	H11
LK121	H11
LK122	H11
LK123	I11
LK124	I12
LK125	G11
LK126	G11
LK127	G11
LK128	G11
LK129	G11
LK130	G11
LK131	G11
LK132	G11
LK134	J12
LK135	J12
LK136	G14
LK137	G4
LK138	F4
LK139	F4
LK140	F4
LK141	F4
LK142	F4
LK143	F4
LK144	F5
LK145	F5
LK146	F5
LK147	F5
LK148	F5
LK149	F5
LK150	F5
LK151	F6
LK152	F6
LK153	F6
LK154	F6
LK155	F6
LK156	F6
LK157	F6
LK158	F7
LK159	F5
LK160	F5
LK161	F6
LK162	E6
LK163	F6
LK164	F6
LK165	E6
LK166	E6
LK167	E7
LK168	F7
LK169	F7
LK170	F7
LK171	F7
LK172	F7
LK173	F7
LK174	F7
LK175	F8
LK176	F8
LK177	F8
LK178	F8
LK179	F9
LK180	F9
LK181	F9
LK183	F9
LK184	F9
LK186	F8
LK187	C3
LK188	D4
LK189	D4
LK190	D4
LK191	D4
LK192	D5
LK193	D5
LK194	D6
LK195	D6
LK196	D6
LK197	D7
LK198	D7
LK199	D7
LK200	D7
LK201	C3
LK202	C4
LK203	C4
LK204	C5
LK205	C5
LK206	C5
LK207∞	C5
LK208	C5
LK209	C5
LK210	C5
LK211	C5
LK212	C7
LK213	C6
LK214∞	C7
LK215	B7
LK216	B7
LK217	B7
LK218	C7
LK219	C8
LK220	B7
LK221	E7
LK222	F8
LK223	F7
LK224	F7
LK225	E7
LK226	E7
LK227	F7
LK228	E8
LK229	E8
LK230	E7
LK231	D8
LK232	D9
LK233	D9
LK234	D9
LK235	E9
LK236	E9
LK237	E9
LK238	D9
LK239	D9
LK240	C9
LK241	C9
LK242	C8
LK243	C9
LK244	C9
LK245	C9
LK246	C9
LK247	C9
LK248	C9
LK249	B9
LK250	B9
LK251	B9
LK252	B9
LK253	C10
LK254	B11
LK255	C11
LK256	D11
LK257	D10
LK258	H6
LK259	E10
LK260	F9
LK261	F10
LK262	F10
LK263	F10
LK264	F10
LK265	F11
LK266	F10
LK267	F11
LK268	F11
LK269	E10
LK270	E11
LK271	F11
LK272	F11
LK273	F11
LK274	F11
LK275	F11
LK276	F12
LK277	F12
LK278	E11
LK279	E11
LK280	E11
LK281	E12
LK282	E12
LK283	F13
LK285	E12
LK286	E12
LK287	F12
LK288	F13
LK289	E12
LK290	E12
LK291	E12
LK292	E12
LK293	E12
LK294	E12
LK295	E12
LK296	E12
LK297	D12
LK298	D12
LK299	D13
LK300	E7
LK301	E9
LK302	F10
LK303	G12

CONNECTORS

PL1*	J7
PL1A*	C12
PL3*	H12
PL101*	H7
PL102*	J4
PL103*	J4
PL104*	J5
PL301*	B9
PL302*	B7
PL304*	C4
PL305*	C4
PL306*	C4
PL308*	D7
PL309*	B10
PL310*	B10
PL312*	B9
PL331*	F9
PL334*	D11
PL336*	E5
PL337*	E5
PL338*	E6
PL339*	D6
PL353*	G6
PL354*	I7
PL355*	G5
PL360*	G6
PL3013*	D12
PL3310*	E5
SK1	B2
SK2	B4
SK3	B7
SK4	B10
SK5	B8
SK6*	B11
SK7*	E10

TRANSISTORS

Q1	B14†
Q2	C13†
Q3	E12†
Q4	E13†
Q5	G3
Q6	I4
Q7	I5†
Q8	I5†
Q9	I5†
Q10	J5
Q11	K6†
Q12	J6†
Q13	K6†
Q14	K5†
Q15	G8†
Q16	J8†
Q17	I8†
Q18	G8†
Q19*	G11†
Q20	H4
Q21*	F12†
Q22*	F12†
Q23	D11†
Q24*	F13
Q24A*	F13
Q25	F13
Q25A*	F13
Q26	F14†
Q27	F12†
Q28*	F12†
Q29	K8†
Q30	K4
Q31	K3†
Q32	K3†
Q33	F14†
Q34	I6†
Q35	I7†
Q36	E4†
Q37	C7†
Q38	C7†
Q39	D7†
Q40	D9†
Q41	D10†
Q42	D9†
Q43	D10†
Q44	E9†
Q45	E9†
Q46	F9†
Q47	E10†
Q48	E10†
Q49	E9†
Q50	E9†
Q51	B4
Q52	C8†
Q53	B8†
Q54*	C11†
Q55	C12†
Q56	C12†
Q57	C6†
Q58	C6†
Q59	C6†
Q60	B6†
Q61	B6†
Q62	B4†
Q63	C8†
Q64*	C12†
Q65	J12†
Q66	C5†
Q67	C10†
Q68	C10†
Q69	C10†
Q70*	B4†
Q71	D4†
Q72	G7†
Q78*	K6†
Q79	E9†
Q80*	H8†
Q81*	H8†
Q82*	H8†
Q83*	H8†
Q85	G4†
Q86	G4
Q90	D8†
Q91	D8†
Q92	D9†
Q93	D9†
Q94	F9†
Q95	D10†

RESISTORS

R1	B14†
R2	B14†
R3	B14†
R4	B14†
R5	B14†
R6	B13†
R7	B13†
R8	B14†
R9	B14†
R10	C13†
R11	C13†
R12	C13†
R13	B13†
R14	C13†
R15*	B13†
R16	B13†
R17	B13†
R18	B13†
R20	D13†
R21	C13†
R22	C13†
R23	D13†
R24	C14†
R25	C14†
R26	D13†
R27	E12†
R28	E13†
R29	E13†
R30	E13†
R31	E13†
R32	C14†
R33	B14†

GRID REFS - IDENT DIAGRAMS FOR MAIN PCB (cont.)

R34	B14†	R105*	K5†	R178	H4†	R249	C7†	R320	B9†
R35	C13†	R106	G9†	R179	H4†	R250	C7†	R321	B9†
R36	B13†	R107	G8†	R180	G4†	R251	C6	R322*	C11†
R37	C13†	R108	G8†	R181*	B12†	R252	D7†	R323*	C11†
R38	C14†	R109	G8†	R182*	B12†	R253	D7†	R324*	C11†
R39	D13†	R110	H10†	R183*	F12†	R254	D7†	R325*	C11†
R40	D13†	R111	H10†	R184*	F12†	R255	D6†	R326*	C11†
R41	C13†	R112	G9†	R185*	F12†	R256	D6†	R327	C11†
R42	C9†	R113	I10†	R186*	F12†	R257	D7†	R328	C12†
R43	C9†	R114	H7†	R187*	F12†	R258	E7†	R329	D11†
R44	C13†	R115	G10†	R188	D12†	R259	D10†	R330	C12†
R45	D13†	R116	I9†	R189	D12†	R260	C9†	R331	C12†
R46	B6†	R117	I9†	R190	D12†	R261	D10†	R332	B6†
R47	D4†	R118	I9†	R191°	D11†	R262	D9†	R333	B6†
R48	E12†	R119	I9†	R192	D12†	R263	D9†	R334*	B6†
R49	B3	R120	I9†	R193	D11†	R264	D9†	R335	B6†
R50	F2	R121	I9†	R194	F13†	R265	D10†	R336	C6†
R51	F3	R122	I9†	R195	F12	R266	D9†	R337	C6†
R52	G3†	R123	I9†	R196*	F12	R267	D9†	R338	C7†
R53	E3†	R124	H9†	R197	F13†	R268	D9†	R339	C6†
R54	E3†	R125	I10†	R198	F14†	R269	D10†	R340	B6†
R55	E3†	R126	J9†	R199	F13†	R270	D10†	R341	B6†
R56	E3†	R127	G10†	R200*	F13†	R271	E10†	R342	B6†
R57	E3†	R128	J9†	R201*	F12†	R272*	E10†	R343	B5†
R58	C3	R129	H9†	R202*	F12†	R273	E9†	R344	B5†
R59	D2	R130	J10†	R203*	F12†	R274	E9†	R345	C6†
R60	G2	R131	J10†	R204*	F12†	R275	F9†	R346	B6†
R61	G3	R132	I10†	R205	F12†	R276	F9†	R347	B5†
R62	F3	R133	I10†	R206*	F12†	R277*	F9†	R348	B3†
R63	F3	R134	H10†	R207	K8†	R278	E10†	R349	B9†
R64	D3†	R135	H9†	R208	K8†	R279	F9†	R350	C4†
R65	D3	R136	H9†	R209	K8†	R280	E10†	R351	C5†
R66	C3	R137	I10†	R210	K7†	R281	E10†	R352*	B5†
R67	C3	R138	J7†	R211	K4†	R282	E9†	R353	C4†
R68	G3	R139	J7†	R212	K4	R283	E9†	R354	C4†
R69	I4†	R140	J7†	R213	K3†	R284	D8†	R355	D8†
R70	H4†	R141	I8†	R214*	K3†	R285*	D8†	R356	C8†
R71	H5†	R142	J8†	R215	K3†	R286	E8†	R357	E14†
R72*	E5†	R143	J8†	R216	I6†	R287	E9†	R358	C4†
R73	C14†	R144	J8†	R217	I7†	R288	E9†	R359	C4†
R74	I5†	R145	G8†	R218	I6†	R289	E9†	R360	C4†
R75	I5†	R146	J8†	R219	I7†	R290	F9†	R361	C4†
R76	I5†	R147	J8†	R220	I6†	R291	F7†	R362	E9†
R77	I5†	R148	J8†	R221*	G14†	R292	F6†	R363	B9†
R78	I5†	R149	I8†	R222	E4†	R293	E6†	R364	C9†
R79	I5†	R150	I8†	R223	E4†	R294	B3†	R365*	C12†
R80	J5†	R151	I10†	R224	E4†	R295	B4†	R366*	C12†
R81	J5†	R154	G9†	R225	F4†	R296	E11†	R367*	C12†
R82	H6†	R155	H8†	R226	E4†	R297	E11†	R368	J12†
R83*	H13†	R156	J8†	R227	F4†	R298	D11†	R369	J12†
R84	G11†	R157	C4†	R228	B11†	R299	D11†	R370	J12†
R85	H6†	R158*	J4	R229	B11†	R300	D11†	R371	H6†
R86	H5†	R159	H8†	R230	B11†	R301	D11†	R372	D13†
R87	J5†	R160	J9†	R231	B11†	R302	D11†	R373	B9†
R88	K5†	R161	G7†	R232	B7†	R303	D11†	R374	C4†
R89	K5†	R162*	G11†	R233	B7†	R304	C11†	R375	B4†
R90	K5†	R163*	G14†	R234	C6†	R305	C10†	R376	B6†
R91	K5†	R164	I10†	R235	B6†	R306*	E9†	R377	B6†
R92	K5†	R165	J11†	R236	B5†	R307	B4†	R378	C4†
R93	K4†	R166	H12†	R237	B5†	R308	B3†	R379	E13†
R94	K4†	R167	H12†	R238	B5†	R309	C4†	R380	C10†
R95*	K6†	R168	H12†	R239	B5†	R310	E9†	R381	C10†
R96*	J6†	R169	H12†	R240	B8†	R311	C8†	R382	C10†
R97*	K6†	R170	H12†	R241	B8†	R312	B8†	R383	C10†
R98	K6†	R171	H12†	R242	C7†	R313	B8†	R384*	C10†
R99	J6†	R172	H12†	R243	C7†	R314	C8†	R385	C9†
R100	J6†	R173	H12†	R244	C7†	R315	C8†	R386	E9†
R101*	K6†	R174	H12†	R245	C7†	R316	B8†	R387	F9†
R102*	J5†	R175	H12†	R246	C7†	R317	B8†	R388*	F8†
R103	C4†	R176	H12†	R247	C7†	R318	B8†	R389	F14†
R104	K5†	R177	H4†	R248	C7†	R319	B10†	R390	H6†

R391*	I6†	R475	B11†
R392	F3	R476	J6†
R393*	C5†	R477	I5†
R394*	B4†	R478	J4†
R395*	B4†	R479	F9†
R396	G6†	R480	B11†
R399*	G14†	R481	I12†
R400*	G14†	R482	I11†
R401*	G14†	R483	E11†
R402*	G14†	R484	F11†
R403*	G14†	R485	F11†
R404*	G14†	R486	G7†
R405*	G14†	R488	H12†
R406*	G14†	R489*	E10†
R407*	G13†	R490*	F11†
R408*	G14†	R491	H10†
R409*	G11†	R492	C12†
R410*	G12†	R493	G5†
R411*	E10†	R494	K5†
R412*	E10†	R496	F12†
R413*	E11†	R497	E8†
R414	G7†	R499	F12†
R415	G7†	R500	E10†
R416	D9†	R501	E9†
R421*	G11†	R502	J8†
R422	B5†	R503	H5†
R423*	G13†	R504	G5†
R424*	G13†	R505	D10†
R425*	K6†	R506	C6†
R426*	K6†	R507	E10†
R427*	J7†	R509	C8†
R428*	D8†	R511	D12†
R429*	H8†	R512	C10†
R430*	H8†	R514	C10†
R431*	H8†	R515	H6†
R432*	H8†	R518	F7†
R433*	H8†	R519	D9†
R434*	H8†	R521	F9†
R435*	H8†	R522	H10†
R436*	I9†	R523	H13†
R437*	H8†	R526	F13†
R438	D10†	R527	F13†
R439	J6	R528	D8†
R440	F13	R529	G5†
R441*	F13	R530	G8†
R442	C4†	R531	F5†
R443	C4†	R532	G5†
R444	G7†	R533	D8†
R445	G5†	R534	H5†
R446	D9†	R535	D8†
R447	C11†	R536	H8†
R448	B10†	R539	G6†
R449	E12†	R540	D9†
R450	C6†	R541	D8†
R451	C10†	R542	C9†
R452	K8†	R543	C8†
R454	E10†	R544	G6†
R455	G4†	R545	D8†
R456*	G4†	R546*	J7†
R457	G4†	R547	G8†
R458	G4†	R548	G4†
R459	G4†	R549	G5†
R460	G4†	R550	D8†
R461	C9	R551	D9†
R462	D11†	R552	G5†
R463	E11†	R555	I10†
R465	D8†	R557	E11†
R467	G11†	R559	F14†
R468*	J5†	R560	H12†
R470*	J6†	R562	K8†
R472*	J6†	R563	I10†
R474	C12†	R564	I9†

R566	K4†
R567	G6†
R568	G6†
R569	G5†
R571	D8†
R573	H5†
R577*	C7†
R578*	G13†
R579*	G13†
R580*	G13†
R581*	G13†
R582*	G12†
R583*	G13†
R584*	G13†
R585*	G12†
R586	D5†
R588	G8†
R589	G8†
R590*	C7†
R591*	C7†
R592	J5†
R593	I5†
R594*	H7†
R598	E8†
R599	E8†
R600	H5†
R601	G9†
R602	G7†
R603	C10†
R604*	G9†
R605*	E9†
R606	B8†

ICS

U1	C13
U2	D14
U3	E3
U4§	H5
U5	H6†
U6	J5
U7	G7
U8	G9
U9	G10
U10	I9
U11	I10
U12	I8
U13	I11
U14	E5
U15	G12†
U16	D11
U17	E8
U18	E7†
U19*	C11†
U20	C4†
U21	F8†
U22	G6†
U23*	G13
U24*	E10
U25*	G13
U26	G5
U27*	F10

MISC. COMPONENTS

CARD1	I13
CARD2*	I13
CARD3*	I13
FS1	B3
IR1	K3
LED1	K4
LED2*	K5
LED3*	K6
LED4*	K6
LED5*	K6
MAC1*	D5
MAC2*	D5
MOD1	C13
REG1*	E10
REG2*	F10
SW1A*	K11
SW1B	K8
SW2	K10
SW3	K10
SW4A*	K11
SW4B	K9
T1	C2
T2	H3
T3*	C2
TST1	J10
TST2*	I11
TST3*	F5
TST4*	H11
TUNER1	C12
W1A	C11
W1B*	B6
X1§	G6
X2	G10
X3	J8
X4	D6
X5	E6
X6	E8
X7*	D10

Notes: (i) T3 is a substitute transformer for T1 in some instances (different pitch)

GRID REFS - MAIN CIRCUIT (DIAGRAM ON SEPARATE SHEET)

* = not fitted
^ = actually a link (in an inductor position)
° = actually a capacitor (in a resistor position)
◊ = actually a zerohm link (in a capacitor position)
∞ = actually a diode (in a link position)
§ = not fitted if there is a U4 extension PCB
A = component of different pitch could be fitted

NOTE: Links and zerohm resistors in the "options" circuitry are fitted, even if the receiver does not have the option.

CAPACITORS

C1	C2
C2	C2
C3	C2
C4	C2
C5	B1
C6	C2
C7	C1
C8	C1
C9	C2
C10	C1
C11	C1
C12	C1
C13	C1
C14*	C1
C15*	B1
C16	C1
C17	B1
C18	B2
C19	B2
C20	B2
C21	B1
C22	B1
C23	B1
C24	B2
C25	B1
C26	B1
C27	B1
C28	B1
C29	B1
C30	B1
C31	B1
C32	B1
C33	B2
C34	B2
C35*	B2
C36	B2
C37	B2
C38	B2
C39	B2
C40	B2
C41	B2
C42	B2
C43*	B2
C44	B2
C45	B1
C46	B1
C47	B1
C48	B1
C49	B1
C50	B1
C51	B2
C52	B1
C53	A1
C54	A1
C55	A2
C56	C6
C57	A2
C57A*	A2
C58	A2
C59	A2
C60	A2
C61	A1
C62	A1
C62A*	A1
C63	D4
C64	A2
C65	A2
C66	A2
C67	A2
C68	A2
C69	A2
C70	A2
C71	A2
C72	A2
C73	A2
C74	A2
C75	A2
C76	A2
C77	A3
C78	A3
C79	B1
C80	A6
C81	C6
C82	D4
C83	A3
C84	A4
C85	A4
C86§	A4
C87§	A4
C88	B4
C89	B3
C90*	B4
C101*	A2
C120*	B2
C127	D4
C137	D6
C138*	D5
C139*	D6
C140	D6
C141	D6
C142	D6
C143	C5
C144	C6
C145	C6
C146*	A2
C147	B5
C148	A5
C149	A5
C150	A5
C151	A5
C152	A5
C153	A4
C154	A5
C155	A5
C156	A5
C157	A5
C158	A6
C159	A6
C160	B6
C161	B6
C162	C6
C163	C6
C164	A6
C165	A6
C166	B6
C167	B6
C168	C6
C169	C6
C170	B5
C171	B5
C172	B5
C173	B6
C174	B6
C175	B5
C176	A5
C177	A5
C178	A5
C179	A5
C180	A5
C181	A6
C182	A5
C183	A5
C184	A5
C185	A5
C186	A6
C187	A6
C188	B5
C189	B5
C190	B5
C191	B5
C192	B5
C193	B5
C194	D4
C195	D4
C196	D4
C197	D4
C198	D4
C199	D4
C200	D3
C201	D3
C202*	D3
C203	D3
C204	D3
C205	D3
C206	D3
C207	D4
C208	D4
C209	D4
C210	D4
C211	D3
C212	D3
C213	D3
C214	D3
C215	D3
C216	D3
C217	D4
C218	D4
C221	D4
C222	D4
C223	D4
C224	D4
C225	D5
C226*	D2
C227*	D2
C228*	D2
C229*	D2
C230	D3
C231	D3
C232*	C6
C233	D4
C234	A6
C235*	A6
C236	A6
C237*	D5
C238	D5
C239*	D5
C240	D5
C241	B6
C242	C6
C243	B6
C244	B5
C245	C5
C246	C5
C247	C5
C248	C6
C250	A3
C252	D4
C253	D4
C254	D4
C255	D4
C256	D5
C257	C6
C258	C6
C261	C5
C262	B1
C264	A4
C265	A5
C266	A5
C267◊	B5
C268	B6
C269	B6
C270	C6
C271	A6
C272*	B3
C273*	B3
C274*	B2
C275*	B2
C276*	B3
C278	D5
C279	D5
C280*	B3
C281*	B6
C282	D6
C283	D4
C285	A4
C286*	B2
C287*	B2
C288*	B2
C289	B6
C290	A6
C291	D4
C292	D4
C294	D6
C295	D6
C296*	B2
C297*	B3
C298*	B2
C299	D4
C300	D4
C301	D3
C302◊	D6
C303	D6
C305	D6
C306	A4
C307◊	B2
C309	D4
C310	A4
C311*	B2
C312*	D2
C317	B1

DIODES

D1	C2
D2	B2
D3	B1
D4	A1
D5	B1
D6	A1
D7	A1
D8	A1
D9	A2
D10	A2
D11	A2
D12	A2
D13	A2
D14	A1
D15	A2
D16	A2
D17	A2
D18	A2
D19*	A3
D29	D6
D30*	D6
D31	C6
D32	C6
D33	C6
D34	C6
D35	C5
D36	C5
D37	A6
D39	A6
D40	C6
D41	A6
D42	A3
D43	A6
D44	A6
D45	B6
D46	C6
D47*	A2
D57*	B3
D58	D5
D59	D1
D60	D1
D61	D3
D62	B6

INDUCTORS

L1	C2
L2	C2
L3	C1
L4	B1
L5	B1
L6	B2
L7	B1
L8	B2
L9	A3
L10	A2
L11	A3
L12	B3
L16	D4
L20	D4
L21	D3
L24	D6
L25	C5
L26	A2
L28	B5
L29	B5
L30	D4
L31	D4
L32	D3
L33	D3
L34	D4
L35	B1
L38	C5
L39^	C5
L40	A3

LINKS

J1	A3
J2	A5
J3	A5
J4*	A4
J5	D5
J6	C5
J7	A4
J8	D5
LK10	A6
LK18	C6
LK19	C6
LK20*	B2
LK21	C5
LK22	A2
LK23	A1
LK24	D1
LK25	A4
LK26	D6
LK27	D1
LK28	A3
LK29	A1
LK30	A4
LK31	B3
LK32	B3
LK33	B3
LK34	A2
LK35	D1
LK36	B4
LK37	D6
LK38	D6
LK39	A4
LK41	D6
LK42	A3
LK43	D1
LK45	D1
LK46	D1
LK47	B3
LK48	A3
LK49	B1
LK50	B1
LK51	C6
LK52	A5
LK53	D1
LK54	A4
LK55	B3
LK56	B3
LK58	C6
LK61	A5
LK65	D6
LK67	A4
LK68	D6
LK70	C6
LK71	D1
LK72	A4
LK73	A4
LK74	A4
LK75	A4
LK76	C5
LK78	D1
LK80	D6
LK81	D6
LK82	D3
LK83	CC6
LK85	D1
LK87	A3
LK88	D2
LK89	C6
LK92	D1
LK100	A3
LK101	A3
LK102	C6
LK104	D5
LK108	D5
LK110	C5
LK111	A3
LK121	A3
LK129	D5
LK130	B2
LK131	A3
LK132	D5
LK135	D5
LK136	D5
LK137	A2
LK138	A2
LK139	D1
LK140	B1
LK141	D5
LK142	A1
LK143	A5
LK144	A1
LK145	A5
LK146	C5
LK147	A4
LK148	A6
LK149	A6
LK150	D6
LK151	B4
LK152	D1
LK153	D4
LK154	D5
LK155	A4
LK156	D1
LK158	A5
LK159	A4
LK160	B1
LK161	D1
LK162	D2
LK163	A6
LK164	B1
LK165	B1
LK166	C6
LK167	D2
LK168	C6
LK169	D3
LK170	A4
LK171	D2
LK174	A3
LK176	D2
LK177	D3
LK178	D3
LK180	B4
LK181	D5
LK186	B2
LK187	D5
LK188	D5
LK189	C6
LK190	C6
LK191	D3
LK192	C6
LK193	C6
LK194	A1
LK195	A5
LK196	A5
LK197	C6
LK198	B5
LK199	B4
LK200	B1
LK201	D1
LK202	C5
LK203	D1
LK204	B5
LK205	A1
LK206	D5
LK207∞	B6
LK208	B6
LK209	B6
LK210	C5
LK211	B4
LK212	D5
LK213	B4
LK214∞	A6
LK215	C5
LK216	A6
LK217	A6
LK218	B4
LK219	D1
LK220	B4
LK221	D5
LK223	D2
LK224	D3
LK225	B1
LK226	A4
LK227	D2
LK229	D2
LK230	B1
LK231	D5
LK232	D2
LK233	B4
LK234	D3
LK235	D1
LK236	D3
LK237	D2
LK238	B4
LK239	D1
LK240	B1
LK241	B4
LK242	A6
LK243	C5
LK244	D3
LK245	A6
LK246	A6
LK247	B4
LK248	D1
LK249	A6
LK250	C5
LK251	A6
LK252	A6
LK253	B4
LK254	C5
LK255	D5
LK256	D1
LK257	D4
LK258	D4
LK259	D4
LK260	A4
LK261	D1
LK262	B2
LK263	B3
LK264	B3
LK265	D4
LK266	B3
LK267	B2
LK268	D4
LK269	D1
LK270	D4
LK271	D4
LK272	A2
LK273	D1
LK274	A5
LK275	D1
LK276	C5
LK277	B1
LK278	D3
LK279	D1
LK280	D1
LK281	D6
LK282	D6
LK283	B1
LK285	D1
LK286	B4
LK287	D6
LK288	D6
LK289	B1
LK290	A4
LK291	B1
LK292	B2
LK293	B4
LK294	D5
LK295	D6
LK296	D6
LK297	B4
LK298	B4
LK299	B2
LK300	B1
LK301	B4
LK302	B2
LK303	B1

CONNECTORS

PL1*	D1
PL1A*	D5
PL101*	A3
PL102*	A3
PL103*	A3
PL104*	A3
PL301*	A6
PL302*	B6
PL304*	C6
PL305*	C6
PL306*	C6
PL308*	A6
PL309*	B6
PL310*	A6
PL312*	A6
PL331*	D2
PL331*	D3
PL334*	D4
PL336*	A5
PL337*	A5
PL338*	B5
PL339*	B5
PL353*	A4
PL354*	A4
PL355*	A4
PL360*	A4
PL3013*	D5
PL3310*	A5
SK1	A1
SK2	C6
SK3	B6
SK4	A6

GRID REFS - MAIN CIRCUIT DIAGRAM (cont.)

SK5	B6
SK6*	B6
SK7*	B2

TRANSISTORS

Q1	C2
Q2	C1
Q3	B1
Q4	B1
Q5	A2
Q6	A3
Q7	A3
Q8	A3
Q9	A3
Q10	A3
Q11	B3
Q12	B3
Q13	B3
Q14	A3
Q19*	B3
Q21*	D6
Q22*	D6
Q23	D6
Q24*	D6
Q24A*	D6
Q25	D6
Q25A*	D6
Q26	C6
Q27	D6
Q28*	D6
Q29	C5
Q30	C5
Q31	C5
Q32	C5
Q33	C6
Q34	C6
Q35	C6
Q36	A5
Q37	B6
Q38	B6
Q39	B5
Q40	D4
Q41	D3
Q42	D3
Q43	D3
Q44	D3
Q45	D3
Q46	D2
Q47	D2
Q48	D2
Q49	D3
Q50	D3
Q51	C6
Q52	A6
Q53	A6
Q54*	D5
Q55	D5
Q56	D5
Q57	B6
Q58	B6
Q59	B6
Q60	B6
Q61	B6
Q62	B5
Q63	D5
Q64*	D5
Q66	B5
Q67	D5
Q68	D5
Q69	D5
Q70*	B4
Q71	B5
Q78*	A3
Q79	D3
Q80*	D2
Q81*	D2
Q82*	D1
Q83*	D2
Q85	A6
Q86	A6
Q90	D3
Q91	D5
Q92	D5
Q93	D5
Q94	D2
Q95	D5

RESISTORS

R1	C2
R2	C2
R3	C2
R4	B2
R5	B2
R6	C2
R7	C2
R8	C2
R9	C1
R10	C1
R11	C1
R12	C1
R13	B1
R14	C1
R15*	C1
R16	C1
R17	B1
R18	B1
R20	B1
R21	B1
R22	B1
R23	B1
R24	B2
R25	B2
R26	B1
R27	B1
R28	B1
R29	B1
R30	B1
R31	B1
R32	C2
R33	C1
R34	C1
R35	C1
R36	C1
R37	B1
R38	B1
R39	B1
R40	B1
R41	B1
R44	B1
R45	B1
R46	B6
R47	B5
R48	B1
R49	A1
R50	A2
R51	A2
R52	A2
R53	A2
R54	A2
R55	A2
R56	A2
R57	A2
R58	A1
R59	A2
R60	A2
R61	A2
R62	A2
R63	A2
R64	A2
R65	A2
R66	A2
R67	A2
R68	A1
R69	A3
R70	A3
R71	A3
R72*	B5
R73	B2
R74	A3
R75	A3
R76	A3
R77	A3
R78	A3
R79	A3
R80	A3
R81	A3
R82	A4
R84	A4
R85	A4
R86	B4
R87	A3
R88	A3
R89	A3
R90	A3
R91	A3
R92	A3
R93	A3
R94	A3
R95*	A3
R96*	A3
R97*	A3
R98	B3
R99	B3
R100	B3
R101*	B3
R102*	B3
R103	C5
R104	A3
R105*	A3
R157	C6
R158*	A2
R162*	B2
R163*	B2
R181*	D6
R182*	D5
R183*	D6
R184*	D6
R185*	D6
R186*	D6
R187*	D6
R188	D6
R189	D6
R190	D6
R191°	D6
R192	D6
R193	D6
R194	D6
R195	D6
R196*	D6
R197	D6
R198	C6
R199	D6
R200*	D6
R201*	D6
R202*	D6
R203*	D6
R204*	D6
R205	D6
R206*	D6
R207	C5
R208	C5
R209	C5
R210	C5
R211	C5
R212	C5
R213	C5
R214*	C5
R215	C5
R216	C6
R217	C6
R218	C6
R219	C6
R220	C6
R221*	B2
R222	A5
R223	A5
R224	A5
R225	A5
R226	A5
R227	A5
R228	A6
R229	A6
R230	A6
R231	A6
R232	B6
R233	B6
R234	B6
R235	B6
R236	C6
R237	C6
R238	C6
R239	C6
R240	B6
R241	B6
R242	B6
R243	B6
R244	B6
R245	B6
R246	B6
R247	B6
R248	B6
R249	B6
R250	B6
R251	A6
R252	B5
R253	B5
R254	B5
R255	B5
R256	B5
R257	B5
R258	B5
R259	D4
R260	D4
R261	D4
R262	D4
R263	D4
R264	D3
R265	D3
R266	D3
R267	D3
R268	D3
R269	D3
R270	D3
R271	D3
R272*	D3
R273	D3
R274	D3
R275	D3
R276	D3
R277*	D3
R278	D2
R279	D2
R280	D2
R281	D2
R282	D2
R283	D2
R284	D4
R285*	D4
R286	D3
R287	D3
R288	D3
R289	D3
R290	D3
R291	D1
R292	D2
R293	D2
R294	B6
R295	C6
R296	D4
R297	D4
R298	D4
R299	D4
R300	D5
R301	D4
R302	D4
R303	D5
R304	D4
R305	D5
R306*	D3
R307	C6
R308	C6
R309	C6
R310	D3
R311	A6
R312	A6
R313	A6
R314	A6
R315	A6
R316	A6
R317	A6
R318	A6
R319	A6
R320	A6
R321	A6
R322*	D5
R323*	D5
R324*	D5
R325*	D5
R326*	D5
R327	D5
R328	D5
R329	D5
R330	D5
R331	D5
R332	B6
R333	B6
R334*	B6
R335	B6
R336	B6
R337	B6
R338	B6
R339	B6
R340	B6
R341	B6
R342	B6
R343	B6
R344	B6
R345	B6
R346	B6
R347	C6
R348	B6
R349	A6
R350	C5
R351	B5
R352*	B5
R353	B5
R354	B5
R355	D5
R356	D5
R357	C5
R358	C5
R359	C5
R360	C5
R361	C5
R362	D2
R363	A6
R364	A6
R365*	D5
R366*	D5
R367*	D5
R371	A4
R372	B1
R373	A6
R374	C6
R375	C6
R376	B5
R377	B5
R378	B5
R379	C5
R380	D5
R381	D4
R382	D5
R383	D4
R384*	D4
R385	D4
R386	D3
R387	D3
R388*	D2
R389	C6
R390	C6
R391*	C6
R392	A2
R393*	B4
R394*	B4
R395*	B4
R396	A3
R399*	B2
R400*	B2
R401*	B2
R402*	B2
R403*	B2
R404*	B2
R405*	B2
R406*	B2
R407*	A2
R408*	A2
R409*	B3
R410*	B3
R411*	B2
R412*	B2
R413*	B2
R415	D4
R416	D1
R421*	B3
R422	C6
R423*	B3
R424*	B3
R425*	A3
R426*	B3
R427*	A3
R428*	D2
R429*	D2
R430*	D2
R431*	D2
R432*	D2
R433*	D2
R434*	D2
R435*	D2
R436*	D1
R437*	D2
R438	D4
R439	A3
R440	D6
R441*	D6
R442	C6
R443	C6
R444	A4
R445	A3
R446	D3
R447	D5
R448	A6
R449	C5
R450	A1
R451	D6
R452	C5
R454	D4
R455	A6
R456*	A6
R457	A6
R458	A6
R459	A6
R460	A6
R461	A6
R462	D4
R463	D4
R465	D5
R468*	B3
R470*	B3
R472*	B3
R474	D5
R475	B6
R476	B4
R477	D6
R478	B4
R479	D6
R480	D6
R483	D4
R484	A2
R485	D1
R486	A3
R489*	B3
R490*	B3
R492	D5
R493	A4
R494	A3
R496	D6
R497	D2
R499	A1
R500	D1
R501	D2
R502	C6
R503	A4
R504	B4
R505	D5
R506	D1
R507	D4
R509	D1
R511	D6
R512	D1
R514	D6
R515	A4
R518	B1
R519	D4
R521	D2
R523	B2
R526	D6
R527	D6
R528	D3
R529	A5
R531	B6
R532	A3
R533	D5
R534	D1
R535	D3
R539	D1
R540	D5
R541	D5
R542	D5
R543	D5
R544	A4
R545	D5
R546*	B4
R548	A3
R549	B2
R550	D5
R551	D5
R552	B4
R557	D6
R559	A4
R562	B4
R566	A4
R567	A3
R568	D1
R571	D4
R573	A4
R577*	B6
R578*	B3
R579*	B3
R580*	B3
R581*	B3
R582*	B3
R583*	B2
R584*	B2
R585*	B2
R586	C5
R589	C6
R590*	B6
R591*	B6
R592	A4
R593	A4
R594*	A4
R598	D3
R599	D3
R600	A4
R603	D5
R605*	D3
R606	A6

ICS

U1	B2
U2	B2
U3	A2
U4§	A4
U5	A4
U6	A3
U7	A4
U14	B5
U16	D4
U17	D4
U18	D2
U19A*	D5
U19B*	D5
U19C*	D5
U20	C5
U21A	D2
U22A	A3
U22B	A3
U23*	B2
U24A*	B2
U24B*	B3
U25*	B3
U26	B2
U27*	B2

MISC. COMPONENTS

FS1	A1
IR1	B4
LED1	A3
LED2*	A3
LED3*	A3
LED4*	A3
LED5*	A3
MAC1*	A5
MAC2*	A5
MOD1	C1
REG1*	B2
REG2*	B2
SW1A*	B4
SW1B	B4
SW2	B4
SW3	B4
SW4A*	A5
SW4B	B4
T1	A1
T2	A2
T3*	A1
TST3*	D6
TUNER1	D6
W1A	D4
W1B*	B6
X1§	A4
X4	B5
X5	B5
X6	D3
X7*	D3

GRID REFS - MAIN CIRCUIT DIAGRAM (cont.)

INTERCONNECTIONS

NOTE: Grid refs preceded by V are on the VideoCrypt circuit diagram.

+27VSW	A3, VD2
27/36	D5, D5
16-INHIBIT	B2, B5
AUDIO I/F	B5, D5
AUDIO_MOD	A5, B1
AUTH_SWITCH	B5, VB3
BANDWIDTH	A4, D5
BLOCK	D2, VB5
CARDDETI/P	A4, VD2
CARDSEL	B2, VD2
CBAND	D3, D5
CE_GRAPHICS	A4, D4
CE_NICKY	A4, D4
CHAR	D1, VB5
CLAMPED	D2, D5
CLAMPED_DEC_VID	D3, D4
CLMP_REF	D2, VC5
DATA	A3, A4, A5, B2, B2, D4
DEC_STAT	A4, A6
DISH_POS	A4, A6
EXT_DEC	A6, D2, VC5
GR_ON_NOISE	D3, D5
GRUNDIG	B4, C6
HSYNC	D2, D3, VB6
H/V	A4, C5
I2C_CLK	A3, B5
ID_HSYNC	B4, VA4
INT/EXT VIDEO	B5, D3
IRTE_CE	A4, B2
LNB_1/2	D3, D6
LNB_OFF	A2, D6
LNB_OVERLOAD	A5, C5
LNB_VOLTS	C5, D6
MOD_IN	B2, D5
MOD_OUT	B1, D5
MOD_VID	B2, C5
OSC_4MHZ	A3, D4
PORTCE	A4, B2
REL_DRV	A2, A6
RST	A3, A3, A5, D1, VC4, VC5
SERIAL_CLK	A3, B2, B2, D4
STBY	A3, B2
TONE	A4, C6
TUNER_AFC	A4, D5
TV16	B6, C5
TV_STAT	B2, B6
TVVID	B6, C5
VCI/P	D2, VC5
VC_OUT	D1, VC6
VCR/SAT	B5, B5
VC_RST	A4, VB3
VCR_STAT	A5, C6
VCR_VID	C6, D3, D5
VC_STATUS	A5, D3, VB6
VFD_CLK	A3, A3, D1
VFD_FILAMENT	C6, D1
VFD_INT	B4, D1
VFD/MAC_DATA	A4, D1
VSY	D1, D3, VB6, VC4

SPARES - ELECTRICAL PARTS LIST FOR MAIN BOARD

NOTE: ⚠ indicates a safety-critical component; these must only be replaced by components of the correct type as listed in these parts lists.

Capacitors

C1	100UF 35V 5MM RADIAL ELECT' CAP	155-1073751
C2	SMD 56PF 50V 5% CER COG CAP 0805 (TRS)	950-5605501
C3	SMD 33PF 50V 5% CER COG CAP 0805 (TRS)	950-3305501
C4	SMD 56PF 50V 5% CER COG CAP 0805 (TRS)	950-5605501
C5	SMD 12PF 50V 5% CER COG CAP 0805 (TRS)	950-1205501
C6	SMD 220PF 50V 5% CER COG CAP 0805 (TRS)	950-2215501
C7	SMD 220PF 50V 5% CER COG CAP 0805 (TRS)	950-2215501
C8	SMD 18PF 50V 5% CER COG CAP 0805 (TRS)	950-1805501
C9	SMD 220PF 50V 5% CER COG CAP 0805 (TRS)	950-2215501
C10	SMD 220PF 50V 5% CER COG CAP 0805 (TRS)	950-2215501
C11	SMD 12PF 50V 5% CER COG CAP 0805 (TRS)	950-1205501
C12	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C13	SMD 220PF 50V 5% CER COG CAP 0805 (TRS)	950-2215501
C16	SMD 22NF 50V 10% CER X7R CAP 0805 (TRS)	950-2235621
C17	SMD 4.7PF 50V +-0.25PF CER COG CAP 0805	950-0475301
C18	SMD 4.7PF 50V +-0.25PF CER COG CAP 0805	950-0475301
C19	SMD 1.5PF 50V +-0.25PF CER COG CAP 0805	950-0155301
C20	SMD 1.5PF 50V +-0.25PF CER COG CAP 0805	950-0155301
C21	SMD 1.5PF 50V +-0.25PF CER COG CAP 0805	950-0155301
C22	SMD 1.5PF 50V +-0.25PF CER COG CAP 0805	950-0155301
C23	SMD 12PF 50V 5% CER COG CAP 0805 (TRS)	950-1205501
C24	SMD 100PF 50V 5% CER COG CAP 0805 (TRS)	950-1015501
C25	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C26	SMD 22NF 50V 10% CER X7R CAP 0805 (TRS)	950-2235621
C27	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C28	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C29	SMD 150PF 50V 5% CER COG CAP 0805 (TRS)	950-1515501
C30	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C31	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C32	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C33	SMD 220PF 50V 5% CER COG CAP 0805 (TRS)	950-2215501
C34	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C36	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C37	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C38	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C39	SMD 12PF 50V 5% CER COG CAP 0805 (TRS)	950-1205501
C40	SMD 12PF 50V 5% CER COG CAP 0805 (TRS)	950-1205501
C41	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C42	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C44	SMD 10NF 50V 10% CER X7R CAP 0805 (TRS)	950-1035621
C45	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C46	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C47	1UF 35V 5MM RADIAL ELECT' CAP TR	155-1053751
C48	4.7UF 35V 5MM RADIAL ELECT' CAP TR	155-4753751
C49	SMD 22NF 50V 10% CER X7R CAP 0805 (TRS)	950-2235621
C50	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C51	100NF 50V 5MM M/LAYER CER.CAP TR	157-1045751
C52	10UF 50V 5MM 20% RAD ELEC' CAP TR	155-1065751
C53	CLASS X CAP-100NF 250V 20%	159-1048780
C54	47UF 400V 7.5/10MM RADIAL ELECT CAP	155-4769780
C55	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C56	1000UF 25V 5MM RADIAL ELECT' CAP TR	155-1082751
C57	CER CAP 1NF 2KV 7.5MM 10% HR SERIES TR	159-1029651
C58	1000UF 25V DJ3 RADIAL ELECT CAP 5MM TR	855-1082951
C59	22UF 35V 20% 5MM 105DEG RAD ELEC CAP	855-2263751
C60	10UF 35V 20% 105DEG RADIAL ELECT' CAP TR	855-1063751
C61	10UF 35V 20% 105DEG RADIAL ELECT' CAP TR	855-1063751
C62 ⚠	*A* CLASS Y CAP-1NF 250V 20% (TDK-MUR)	159-1028781
C63	1UF 16V 5MM RADIAL ELECT' CAP TR	155-1051751
C64	SMD 220PF 50V 5% CER COG CAP 0805 (TRS)	950-2215501
C65	SMD 47NF 50V 10% CER X7R CAP 0805 (TRS)	950-4735621
C66	220UF 50V 20% 5MM 105DEG 10MM DIA CAP TR	855-2275751
C67	10UF 50V 5MM 20% RAD ELEC' CAP TR	155-1065751
C68	SMD 330PF 50V 10% CER COG CAP 0805 (TRS)	950-3315601
C69	SMD 220NF 50V 20/80% CER Y5V CAP 0805	950-2245951
C70	1000UF 35V DJ3 RADIAL ELECT CAP 5MM TR	855-1083951
C71	SMD 330PF 50V 10% CER COG CAP 0805 (TRS)	950-3315601
C72	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C73	1000UF 25V DJ3 RADIAL ELECT CAP 5MM TR	855-1082951
C74	SMD 330PF 50V 10% CER COG CAP 0805 (TRS)	950-3315601
C75	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C76	2200UF 16V DJ3 5MM RADIAL ELECT' CAP	855-2281950
C77	10UF 25V 5MM RADIAL ELECT' CAP TR	155-1062751
C78	470UF 16V 5MM RADIAL ELECT' CAP TR	155-4771751
C79	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C80	10UF 50V 5MM MINI BIPOLAR RAD ELEC' TR	156-1065752
C81	10UF 35V 5MM RADIAL ELECT' CAP TR	155-1063751
C82	10UF 50V 5MM MINI BIPOLAR RAD ELEC' TR	156-1065752
C83	10UF 35V 5MM RADIAL ELECT' CAP TR	155-1063751
C84	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C85	220UF 16V 5MM RADIAL ELECT' CAP TR	155-2271751
C88	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C89	1000UF 25V DJ3 RADIAL ELECT CAP 5MM TR	855-1082951
C91	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C92	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C93	SMD 10NF 50V 10% CER X7R CAP 0805 (TRS)	950-1035621
C94	SMD 22PF 50V 5% CER COG CAP 0805 (TRS)	950-2205501
C95	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C96	SMD 39PF 50V 5% CER COG CAP 0805 (TRS)	950-3905501
C97	SMD 22PF 50V 5% CER COG CAP 0805 (TRS)	950-2205501
C98	SMD 47PF 50V 5% CER COG CAP 0805 (TRS)	950-4705501
C99	SMD 56PF 50V 5% CER COG CAP 0805 (TRS)	950-5605501
C102	10UF 35V 5MM RADIAL ELECT' CAP TR	155-1063751
C103	SMD 4.7NF 50V 10% CER X7R CAP 0805 (TRS)	950-4725621
C104	SMD 33NF 25V 10% CER X7R CAP 0805 (TRS)	950-3332621
C105	4.7UF 35V 5MM RADIAL ELECT' CAP TR	155-4753751
C106	SMD 3.3NF 50V 5% CER X7R CAP 0805 (TRS)	950-3325521
C107	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C108	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C109	1UF 16V 5MM RADIAL ELECT' CAP TR	155-1051751
C110	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C111	SMD 100PF 50V 5% CER COG CAP 0805 (TRS)	950-1015501
C112	SMD 22PF 50V 5% CER COG CAP 0805 (TRS)	950-2205501
C113	SMD 5.6PF 50V +-0.25PF CER COG CAP 0805	950-0565301
C114	SMD 68PF 50V 5% CER COG CAP 0805 (TRS)	950-6805501
C115	SMD 22PF 50V 5% CER COG CAP 0805 (TRS)	950-2205501
C116	SMD 27PF 50V 5% CER COG CAP 0805 (TRS)	950-2705501
C117	100UF 25V 5MM RADIAL ELECT' CAP TR	155-1072751
C118	22UF 16V 5MM RADIAL ELECT' CAP TR	155-2261751
C119	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C121	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C122	1UF 16V 5MM RADIAL ELECT' CAP TR	155-1051751
C123	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C124	10UF 35V 5MM RADIAL ELECT' CAP TR	155-1063751
C126	SMD 10NF 50V 10% CER X7R CAP 0805 (TRS)	950-1035621
C127	SMD 33PF 50V 5% CER COG CAP 0805 (TRS)	950-3305501
C128	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C129	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C130	SMD 47NF 50V 10% CER X7R CAP 0805 (TRS)	950-4735621
C131	SMD 10NF 50V 10% CER X7R CAP 0805 (TRS)	950-1035621
C132	SMD 10NF 50V 5% CER.CAP 0805	950-1035501
C133	SMD 47PF 50V 5% CER COG CAP 0805 (TRS)	950-4705501
C134	SMD 47PF 50V 5% CER COG CAP 0805 (TRS)	950-4705501
C135	47UF 25V 5MM RADIAL ELECT' CAP TR	155-4762751
C136	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C137	SMD 10NF 50V 5% CER CAP 0805	950-1035621
C140	1000UF 16V 5MM RAD ELEC' CAP (10X16)	155-1081750
C141	SMD 220NF 50V 20/80% CER Y5V CAP 0805 TR	950-2245951
C142	1UF 63V 5MM BOX POLYESTER CAP TR	152-1056651
C143	1UF 50V 5MM RADIAL ELECT' CAP TR	155-1055751

SPARES - ELECTRICAL PARTS LISTS FOR MAIN BOARD (cont.)

C144	SMD 1.8NF 50V 5% CER.COG CAP 0805	950-1825501
C145	SMD 1.8NF 50V 5% CER.COG CAP 0805	950-1825501
C147	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C148	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C149	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C150	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C151	SMD 220PF 50V 5% CER COG CAP 0805 (TRS)	950-2215501
C152	SMD 220PF 50V 5% CER COG CAP 0805 (TRS)	950-2215501
C153	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C154	SMD 22NF 50V 10% CER X7R CAP 0805 (TRS)	950-2235621
C155	1UF 63V 5MM BOX POLYESTER CAP TR	152-1056651
C156	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C157	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C158	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C159	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C160	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C161	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C162	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C163	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C164	SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR	950-3342951
C165	SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR	950-3342951
C166	SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR	950-3342951
C167	SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR	950-3342951
C168	SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR	950-3342951
C169	SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR	950-3342951
C170	SMD 10PF 50V 5% CER CAP 0805 (TRS)	950-1005501
C171	SMD 10PF 50V 5% CER CAP 0805 (TRS)	950-1005501
C172	SMD 56PF 50V 5% CER COG CAP 0805 (TRS)	950-5605501
C173	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C174	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C175	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C176	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C177	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C178	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C179	SMD 470PF 50V 10% CER X7R CAP 0805 (TRS)	950-4715621
C180	SMD 470PF 50V 10% CER X7R CAP 0805 (TRS)	950-4715621
C181	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C182	3.3UF 16V 5MM RADIAL ELECT' CAP TR	155-3351751
C183	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C184	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C185	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C186	100UF 16V 5MM RADIAL ELECT' CAP TR	155-1071751
C187	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C188	SMD 56PF 50V 5% CER COG CAP 0805 (TRS)	950-5605501
C189	SMD 18PF 50V 5% CER COG CAP 0805 (TRS)	950-1805501
C190	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C191	SMD 270PF 50V 5% CER.CAP 0805 (TRS)	950-2715501
C192	SMD 39PF 50V 5% CER COG CAP 0805 (TRS)	950-3905501
C193	SMD 39PF 50V 5% CER COG CAP 0805 (TRS)	950-3905501
C194	SMD 22PF 50V 5% CER COG CAP 0805 (TRS)	950-2205501
C195	SMD 10PF 50V 5% CER CAP 0805 (TRS)	950-1005501
C196	SMD 33PF 50V 5% CER COG CAP 0805 (TRS)	950-3305501
C197	SMD 82PF 50V 5% CER COG CAP 0805 (TRS)	950-8205501
C198	SMD 56PF 50V 5% CER COG CAP 0805 (TRS)	950-5605501
C199	100UF 16V 5MM RADIAL ELECT' CAP TR	155-1071751
C200	SMD 56PF 50V 5% CER COG CAP 0805 (TRS)	950-5605501
C201	SMD 22PF 50V 5% CER COG CAP 0805 (TRS)	950-2205501
C203	SMD 150PF 50V 5% CER COG CAP 0805 (TRS)	950-1515501
C204	SMD 18PF 50V 5% CER COG CAP 0805 (TRS)	950-1805501
C205	470NF 50V 5MM M/L CER.CAP TR(MAX WD 3MM)	157-4745751
C206	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C207	SMD 33PF 50V 5% CER COG CAP 0805 (TRS)	950-3305501
C208	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C209	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C210	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C211	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C212	47UF 16V 5MM RADIAL ELECT' CAP TR	155-4761751
C213	SMD 12PF 50V 5% CER COG CAP 0805 (TRS)	950-1205501
C214	SMD 12PF 50V 5% CER COG CAP 0805 (TRS)	950-1205501
C215	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C216	100UF 16V 5MM RADIAL ELECT' CAP TR	155-1071751
C217	100UF 16V 5MM RADIAL ELECT' CAP TR	155-1071751
C218	SMD 47PF 50V 5% CER COG CAP 0805 (TRS)	950-4705501
C219	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C221	1UF 16V 5MM RADIAL ELECT' CAP TR	155-1051751
C222	SMD 390PF 50V 5% CER COG CAP 0805 (TRS)	950-3915501
C223	SMD 390PF 50V 5% CER COG CAP 0805 (TRS)	950-3915501
C224	SMD 18PF 50V 5% CER COG CAP 0805 (TRS)	950-1805501
C225	SMD 100PF 50V 5% CER COG CAP 0805 (TRS)	950-1015501
C230	SMD 10PF 50V 5% CER CAP 0805 (TRS)	950-1005501
C231	220UF 25V 5MM RADIAL ELECT CAP	155-2272751
C233	220UF 16V 5MM RADIAL ELECT' CAP TR	155-2271751
C234	SMD 150PF 50V 5% CER COG CAP 0805 (TRS)	950-1515501
C236	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C238	47UF 16V 5MM RADIAL ELECT' CAP TR	155-4761751
C240	47UF 16V 5MM RADIAL ELECT' CAP TR	155-4761751
C241	SMD 10NF 50V 10% CER X7R CAP 0805 (TRS)	950-1035621
C242	SMD 10NF 50V 10% CER X7R CAP 0805 (TRS)	950-1035621
C243	47UF 16V 5MM RADIAL ELECT' CAP TR	155-4761751
C244	100UF 16V 5MM RADIAL ELECT' CAP TR	155-1071751
C245	SMD 22PF 50V 5% CER COG CAP 0805 (TRS)	950-2205501
C246	SMD 56PF 50V 5% CER COG CAP 0805 (TRS)	950-5605501
C247	22UF 35V 5MM RADIAL ELECT' CAP	155-2263751
C248	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C249	SMD 10NF 50V 10% CER X7R CAP 0805 (TRS)	950-1035621
C250	SMD 22PF 50V 5% CER COG CAP 0805 (TRS)	950-2205501
C252	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C253	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C254	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C255	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C256	1000UF 25V 5MM RADIAL ELECT CAP	155-1082751
C257	SMD 1.8NF 50V 5% CER COG CAP 0805 (TRS)	950-1825501
C258	SMD 1.8NF 50V 5% CER COG CAP 0805 (TRS)	950-1825501
C259	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C260	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C261	47UF 16V 5MM RADIAL ELECT' CAP TR	155-4761751
C262	100UF 16V 5MM RADIAL ELECT' CAP TR	155-1071751
C264	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C265	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C266	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C267	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
C268	100UF 25V 5MM RADIAL ELECT' CAP TR	155-1072751
C269	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C270	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C271	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C278	22UF 16V 5MM RADIAL ELECT' CAP TR	155-2261751
C279	SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR	950-3342951
C282	SMD 100NF 50V 20/80% CER Y5V CAP 0805 TR	950-1045951
C283	SMD 100PF 50V 5% CER COG CAP 0805 (TRS)	950-1015501
C284	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C285	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C289	100UF 25V 5MM RADIAL ELECT' CAP TR	155-1072751
C290	100UF 25V 5MM RADIAL ELECT' CAP TR	155-1072751
C291	SMD 12PF 50V 5% CER COG CAP 0805 (TRS)	950-1205501
C292	SMD 100PF 50V 5% CER COG CAP 0805 (TRS)	950-1015501
C294	SMD 56PF 50V 5% CER COG CAP 0805 (TRS)	950-5605501
C295	SMD 220NF 50V 20/80% CER Y5V CAP 0805	950-2245951
C299	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C300	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C301	SMD 22PF 50V 5% CER COG CAP 0805 (TRS)	950-2205501
C302	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
C303	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951

SPARES - ELECTRICAL PARTS LISTS FOR MAIN BOARD (cont.)

C305	SMD 100PF 50V 5% CER COG CAP 0805 (TRS)	950-1015501
C306	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C307	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
C308	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
C309	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C310	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C313	SMD 4.7NF 50V 10% CER X7R CAP 0805 (TRS)	950-4725621
C314	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C315	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C316	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C317	SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR	950-3342951

Diodes

D1	SMD DIODE-BAS19/ISS250 (TE85L) SOT-23 TR	912-0001951
D2	SMD DIODE-BB515 MINI PLAST (TRS)	912-0051501
D3	SMD DIODE-BB619 MINI PLAST (TRS)	912-0061901
D4	DIODE-1N4007 TR	120-0400701
D5	5V6 5% 400MW ZENER DIODE TR	125-0056501
D6	DIODE-1N4007 TR	120-0400701
D7	DIODE-1N4007 TR	120-0400701
D8	DIODE-1N4007 TR	120-0400701
D9	DIODE-BYV96D (PHILIPS) TR	120-0009611
D10	DIODE-BYV96D (PHILIPS) TR	120-0009611
D11	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D12	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D13	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D14	3V9 5% 400MW ZENER DIODE TR	125-0039501
D15	DIODE-BYV95A (PHILIPS) TR	120-0009511
D16	DIODE-BYV95A (PHILIPS) TR	120-0009511
D17	DIODE - EGP30B TR	120-1003001
D18	DIODE - EGP30B TR	120-1003001
D20	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D21	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D22	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D23	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D24	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D25	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D26	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D27	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D28	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D29	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D31	6V2 2% 400MW ZENER DIODE TR	125-0062201
D32	6V2 2% 400MW ZENER DIODE TR	125-0062201
D33	5V1 2% 400MW ZENER DIODE TR	125-0051201
D34	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D35	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D36	DIODE - 1N5817 1.0A 20V SCHOTTKY TR	120-0581701
D37	8V2 5% 400MW ZENER DIODE TR	125-0082501
D39	5V6 5% 400MW ZENER DIODE TR	125-0056501
D40	4V7 5% 400MW ZENER DIODE TR	125-0047501
D41	5V6 5% 400MW ZENER DIODE TR	125-0056501
D42	3V0 5% 400MW ZENER DIODE TR	125-0030501
D43	5V6 5% 400MW ZENER DIODE TR	125-0056501
D44	5V6 5% 400MW ZENER DIODE TR	125-0056501
D45	5V6 5% 400MW ZENER DIODE TR	125-0056501
D46	5V6 5% 400MW ZENER DIODE TR	125-0056501
D48	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D49	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D50	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D51	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D58	3V0 5% 400MW ZENER DIODE TR	125-0030501
D59	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D60	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D61	4V7 5% 400MW ZENER DIODE TR	125-0047501
D62	12V 5% 400MW ZENER DIODE	125-0120501

Inductors

L1	200NH-COIL(GOLD) AIR WOUND (PEDOKA)	134-0200080
L2	200NH-COIL(GOLD) AIR WOUND (PEDOKA)	134-0200080
L3	BALUN-BC0403RID-B (PEDOKA)	133-0040300
L4	18NH-COIL (GOLD) AIR WOUND (PEDOKA)	134-0018080
L5	18NH-COIL (GOLD) AIR WOUND (PEDOKA)	134-0018080
L6	15NH-COIL(RED)AIR WOUND(PEDOKA) (A-26MM)	134-0015091
L7	SOUND COIL 4.7UH +-3% SUMIDA HKS-999-035	133-0047051
L8	AXIAL INDUCTOR-33UH 5% TR	130-0330501
L9	INDUCTOR-1A 100UH (TDK TSL1110-101K1RO)	131-1000500
L10	INDUCTOR-1A 100UH (TDK TSL1110-101K1RO)	131-1000500
L11	INDUCTOR-1A 100UH (TDK TSL1110-101K1RO)	131-1000500
L12	AXIAL INDUCTOR-680UH 5% TR	130-6800501
L13	AXIAL INDUCTOR-1UH 5% TR	130-0010501
L14	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611
L15	15UH 5% AXIAL INDUCTOR TR	130-0150501
L16	15UH 5% AXIAL INDUCTOR TR	130-0150501
L17	82UH 10% AXIAL INDUCTOR (TDK) T	134-0820601
L18	200NH-COIL(GOLD) AIR WOUND (PEDOKA)	134-0200080
L19	200NH-COIL(GOLD) AIR WOUND (PEDOKA)	134-0200080
L20	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611
L21	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611
L24	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611
L25	INDUCTOR-1A 100UH (TDK TSL1110-101K1RO)	131-1000500
L26	AXIAL INDUCTOR-100UH 10% DC RES -1.8R TR	130-1000611
L27	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611
L28	AXIAL IND -12UH 5% SRF 19MHZ MIN TR	130-0120501
L29	AXIAL IND -12UH 5% SRF 19MHZ MIN TR	130-0120501
L30	15UH 5% AXIAL INDUCTOR TR	130-0150501
L31	AXIAL INDUCTOR-22UH 10% TR	130-0220601
L32	SOUND COIL 4.7UH +-3% SUMIDA HKS-999-035	133-0047051
L33	AXIAL INDUCTOR-33UH 5% TR	130-0330501
L34	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611
L35	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611
L38	10UH 5% AXIAL INDUCTOR (SIEMENS) TR	130-0100501
L39	TINNED COPPER WIRE LINKS 0.61MM DIA-PMF	999P1099901
L40	82UH 10% AXIAL INDUCTOR (TDK) T	134-0820601
L41	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611
L42	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611
L43	RAD FERR BEAD(PEDOKA BL02RN2-R62T2) TR	133-0226201

Links

J1 to J11 and LK10 to LK303 are all:

	TINNED COPPER WIRE LINKS 0.61MM DIA-PMF	999P1099901

except:

J10	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
J11	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
LK207	5V6 5% 400MW ZENER DIODE TR	125-0056501
LK214	5V6 5% 400MW ZENER DIODE TR	125-0056501

Connectors

SK1 ⚠	*A* LEONHARDY 07-78.1400 MAINS INPUT SKT	875-0778231
SK2	SCART SOCKET-JR21A7 21PIN R/ANGLE	163-2102113
SK3	SCART SOCKET-JR21A7 21PIN R/ANGLE	163-2102113
SK4	SCART SOCKET-JR21A7 21PIN R/ANGLE	163-2102113
SK5	PHONO SOCKET-DUAL (JALCO YKC21-0061)	165-2000201

Transistors

Q1	SMD TRANSISTOR-BFR193 SIEMENS SOT-23	911-0019351
Q2	SMD TRANSISTOR-BFR193 SIEMENS SOT-23	911-0019351
Q3	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q4	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q5	TRANSISTOR-MJE 18004 (MOTOROLA)	110-1800401
Q6	TRANSISTOR-FXT749 (ZETEX) TR	110-0074911
Q7	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q8	SMD TRANSISTOR-BC846B SOT-23	911-1084651

SPARES - ELECTRICAL PARTS LISTS FOR MAIN BOARD (cont.)

Q9	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q10	TRANSISTOR-FXT749 (ZETEX) TR	110-0074911
Q11	SMD TRANSISTOR - FMMT591A/BCW67C(SOT-23)	911-0059151
Q12	SMD TRANSISTOR - FMMT591A/BCW67C(SOT-23)	911-0059151
Q13	SMD TRANSISTOR - FMMT591A/BCW67C(SOT-23)	911-0059151
Q14	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q15	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q16	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q17	SMD TRANSISTOR-FMMT2369A SOT-23	911-0236951
Q18	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q20	POWER TRANSISTOR-BD139 NPN TO-126 PAC.TR	110-0013901
Q23	SMD TRANSISTOR-ZVN3306F SOT-23	911-0330651
Q25	TRANSISTOR - BD329 NPN TO-126 PACKAGE	110-0032901
Q26	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q27	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q29	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q30	TRANSISTOR-FXT749 (ZETEX) TR	110-0074911
Q31	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q32	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q33	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q34	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q35	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q36	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q37	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q38	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q39	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q40	SMD TRANSISTOR-FMMT2369A SOT-23	911-0236951
Q41	SMD TRANSISTOR-FMMT2369A SOT-23	911-0236951
Q42	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q43	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q44	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q45	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q46	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q47	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q48	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q49	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q50	SMD TRANSISTOR-FMMT2369A SOT-23	911-0236951
Q51	TRANSISTOR-BC547B NPN TO-92 PACKAGE TR	110-1054701
Q52	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q53	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q55	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q56	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q57	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q58	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q59	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q60	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q61	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q62	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q63	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q65	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q66	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q67	SMD TRANSISTOR-BFR193 SIEMENS SOT-23	911-0019351
Q68	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q69	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q71	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q72	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q79	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q85	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q86	TRANSISTOR-BC557 PNP TO-92 PACKAGE TR	110-0055701
Q90	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q91	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q92	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q93	SMD TRANSISTOR-BC846B SOT-23	911-1084651
Q94	SMD TRANSISTOR-FMMT2369A SOT-23	911-0236951
Q95	SMD TRANSISTOR-BC846B SOT-23	911-1084651

Resistors

R1	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R2	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R3	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R4	SMD 180R 0.1W 5% RES 0805 (TRS)	940-1810501
R5	SMD 15R 0.1W 5% RES 0805 (TRS)	940-1500501
R6	SMD 12R 0.1W 5% RES 0805 (TRS)	940-1200501
R7	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501
R8	SMD 12R 0.1W 5% RES 0805 (TRS)	940-1200501
R9	SMD 120R 0.1W 5% RES 0805 (TRS)	940-1210501
R10	SMD 560R 0.1W 5% RES 0805 (TRS)	940-5610501
R11	SMD 560R 0.1W 5% RES 0805 (TRS)	940-5610501
R12	SMD 560R 0.1W 5% RES 0805 (TRS)	940-5610501
R13	SMD 150R 0.1W 5% RES 0805 (TRS)	940-1510501
R14	SMD 27R 0.1W 5% RES 0805 (TRS)	940-2700501
R16	SMD 22R 0.1W 5% RES 0805 (TRS)	940-2200501
R17	SMD 12R 0.1W 5% RES 0805 (TRS)	940-1200501
R18	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501
R20	SMD 22K 0.1W 5% RES 0805 (TRS)	940-2230501
R21	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R22	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R23	SMD 22K 0.1W 5% RES 0805 (TRS)	940-2230501
R24	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501
R25	SMD 8K2 0.1W 1% RES 0805 (TRS)	940-8220101
R26	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R27	SMD 1K5 0.1W 5% RES 0805 (TRS)	940-1520501
R28	SMD 2K2 0.1W 5% RES 0805 (TRS)	940-2220501
R29	SMD 1K5 0.1W 1% RES 0805 (TRS)	940-1520101
R30	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R31	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R32	SMD 22R 0.1W 5% RES 0805 (TRS)	940-2200501
R33	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R34	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R35	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R36	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R37	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R38	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R39	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R40	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R41	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R42	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R43	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R44	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R45	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R46	SMD 22R 0.1W 5% RES 0805 (TRS)	940-2200501
R47	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R48	SMD 2K2 0.1W 5% RES 0805 (TRS)	940-2220501
R49	10R 2W +-25% METOX NON-SPIRAL RES	143-1007821
R50	47K 3W 5% 17.5MM FLAME RETARDANT MOR-3W	148-4738501
R51	15R 0.25W 5% CARBON FILM RES TR	140-1502501
R52	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501
R53	SMD 3K3 0.1W 1% RES 0805 (TRS)	940-3320101
R54	SMD 1K 0.1W 1% RES 0805 (TRS)	940-1020101
R55	SMD 2K2 0.1W 1% RES 0805 (TRS)	940-2220101
R56	SMD 9K1 0.1W 1% RES 0805 (TRS)	940-9120101
R57	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R58	100R 0.25W 5% CARBON FILM RES TR	140-1012501
R59	1R 1WATT 5% METOX NON-SPIRAL RES	143-0106521
R60	1K 5W 10% AX/PLUG CER CASE RES H=15MM	145-1029600
R61	2K2 2W 5% METAL FILM RES TR	142-2226511
R62	68R 0.25W 5% CARBON FILM RES TR	140-6802501
R63	68R 0.25W 5% CARBON FILM RES TR	140-6802501
R64	SMD 22K 0.1W 5% RES 0805 (TRS)	940-2230501
R65	4R7 0.25W 5% CARBON FILM RES TR	140-0472501
R66	470R 0.25W 1% METAL FILM RES	141-4712101
R67	470R 0.25W 1% METAL FILM RES	141-4712101

SPARES - ELECTRICAL PARTS LISTS FOR MAIN BOARD (cont.)

R68 ⚠	*A* 10M 0.5W VR37 METAL FILM RES TR	142-1065511	R143	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R69	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R144	SMD 470K 0.1W 5% RES 0805 (TRS)	940-4740501
R70	SMD 270R 0.1W 5% RES 0805 (TRS)	940-2710501	R145	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R71	SMD 270R 0.1W 5% RES 0805 (TRS)	940-2710501	R146	SMD 820R 0.1W 5% RES 0805 (TRS)	940-8210501
R73	SMD 390R 0.1W 5% RES 0805 (TRS)	940-3910501	R147	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R74	SMD 4K7 0.1W 1% RES 0805 (TRS)	940-4720101	R148	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R75	SMD 820R 0.1W 5% RES 0805 (TRS)	940-8210501	R149	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R76	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501	R150	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R77	SMD 12K 0.1W 5% RES 0805 (TRS)	940-1230501	R151	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R78	SMD 220K 0.1W 5% RES 0805 (TRS)	940-2240501	R154	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R79	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501	R155	SMD 5K6 0.1W 5% RES 0805 (TRS)	940-5620501
R80	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501	R156	SMD 47R 0.1W 5% RES 0805 (TRS)	940-4700501
R81	SMD 22K 0.1W 5% RES 0805 (TRS)	940-2230501	R157	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R82	SMD 220K 0.1W 5% RES 0805 (TRS)	940-2240501	R159	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R84	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501	R160	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R85	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501	R161	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R86	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501	R164	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R87	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501	R165	SMD 15K 0.1W 5% RES-0805 (TRS)	940-1530501
R88	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R166	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R89	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R167	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R90	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R168	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R91	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R169	SMD 10R 0.1W 5% RES 0805 (TRS)	940-1000501
R92	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R170	SMD 10R 0.1W 5% RES 0805 (TRS)	940-1000501
R93	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R171	SMD 10R 0.1W 5% RES 0805 (TRS)	940-1000501
R94	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R172	SMD 10R 0.1W 5% RES 0805 (TRS)	940-1000501
R98	SMD 3K9 0.1W 1% RES 0805 (TRS)	940-3920101	R173	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R99	SMD 3K9 0.1W 1% RES 0805 (TRS)	940-3920101	R174	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R100	SMD 3K9 0.1W 1% RES 0805 (TRS)	940-3920101	R175	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R103	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R176	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R104	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R177	SMD 1K2 0.1W 1% RES 0805 (TRS)	940-1220101
R106	SMD 620R 0.1W 5% RES 0805 (TRS)	940-6210501	R178	SMD 1K2 0.1W 1% RES 0805 (TRS)	940-1220101
R107	SMD 390R 0.1W 5% RES 0805 (TRS)	940-3910501	R179	SMD 360R 0.1W 2% RES 0805 (TRS)	940-3610201
R108	SMD 120R 0.1W 5% RES 0805 (TRS)	940-1210501	R180	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R109	SMD 2K2 0.1W 5% RES 0805 (TRS)	940-2220501	R188	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R110	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R189	SMD 22K 0.1W 5% RES 0805 (TRS)	940-2230501
R111	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R190	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R112	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501	R191	SMD 220NF 50V 20/80% CER Y5V CAP 0805 TR	950-2245951
R113	SMD 3K3 0.1W 1% RES 0805 (TRS)	940-3320101	R192	SMD 2K2 0.1W 5% RES 0805 (TRS)	940-2220501
R114	SMD 33K 0.1W 5% RES 0805 (TRS)	940-3330501	R193	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R115	SMD 1K2 0.1W 1% RES 0805 (TRS)	940-1220101	R194	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R116	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R195	1K2 0.25W 5% CARBON FILM RES TR	140-1222501
R117	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R197	SMD 1K2 0.1W 5% RES 0805 (TRS)	940-1220501
R118	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R198	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R119	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R199	SMD 6K8 0.1W 5% RES 0805 (TRS)	940-6820501
R120	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R205	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R121	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R207	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R122	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R208	SMD 1R8 0.1W 5% RES 0805 (TRS)	940-0180501
R123	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501	R209	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R124	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R210	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R125	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R211	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R126	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R212	1K5 0.25W 1% METAL FILM RES TR	141-1522101
R127	SMD 1M 0.1W 5% RES 0805 (TRS)	940-1050501	R213	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R128	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501	R215	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R129	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501	R216	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R130	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R217	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R131	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R218	SMD 12K 0.1W 1% RES 0805 (TRS)	940-1230101
R132	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R219	SMD 12K 0.1W 1% RES 0805 (TRS)	940-1230101
R133	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R220	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R134	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R222	SMD 6K8 0.1W 5% RES 0805 (TRS)	940-6820501
R135	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501	R223	SMD 6K8 0.1W 5% RES 0805 (TRS)	940-6820501
R136	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R224	SMD 15K 0.1W 5% RES 0805 (TRS)	940-1530501
R137	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501	R225	SMD 82K 0.1W 5% RES 0805 (TRS)	940-8230501
R138	SMD 270K 0.1W 5% RES 0805 (TRS)	940-2740501	R226	SMD 2K2 0.1W 5% RES 0805 (TRS)	940-2220501
R139	SMD 3K9 0.1W 1% RES 0805 (TRS)	940-3920101	R227	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R140	SMD 2K7 0.1W 5% RES 0805 (TRS)	940-2720501	R228	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R141	SMD 3K3 0.1W 1% RES 0805 (TRS)	940-3320101	R229	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R142	SMD 2K7 0.1W 5% RES 0805 (TRS)	940-2720501	R230	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501

SPARES - ELECTRICAL PARTS LISTS FOR MAIN BOARD (cont.)

R231	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R232	SMD 1K 0.1W 1% RES 0805 (TRS)	940-1020101
R233	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R234	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R235	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R236	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R237	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R238	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R239	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R240	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R241	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R242	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R243	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501
R244	SMD 39K 0.1W 5% RES 0805 (TRS)	940-3930501
R245	SMD 6K8 0.1W 5% RES 0805 (TRS)	940-6820501
R246	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R247	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501
R248	SMD 39K 0.1W 5% RES 0805 (TRS)	940-3930501
R249	SMD 6K8 0.1W 5% RES 0805 (TRS)	940-6820501
R250	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R251	220R 0.25W 5% CARBON FILM RES	140-2212501
R252	SMD 220R 0.1W 5% RES 0805	940-2210501
R253	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R254	SMD 9K1 0.1W 1% RES 0805 (TRS)	940-9120101
R255	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R256	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R257	SMD 18K 0.1W 1% RES 0805 (TRS)	940-1830101
R258	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501
R259	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R260	SMD 6K8 0.1W 5% RES 0805 (TRS)	940-6820501
R261	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501
R262	SMD 18K 0.1W 5% RES 0805 (TR)	940-1830501
R263	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501
R264	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R265	SMD 270R 0.1W 5% RES 0805 (TRS)	940-2710501
R266	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R267	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501
R268	SMD 150R 0.1W 5% RES 0805 (TRS)	940-1510501
R269	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R270	SMD 680R 0.1W 5% RES 0805 (TRS)	940-6810501
R271	SMD 680R 0.1W 1% RES 0805 (TRS)	940-6810101
R273	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R274	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R275	SMD 560R 0.1W 5% RES 0805 (TRS)	940-5610501
R276	SMD 120R 0.1W 5% RES 0805 (TRS)	940-1210501
R278	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R279	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R280	SMD 180R 0.1W 5% RES 0805 (TRS)	940-1810501
R281	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R282	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R283	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R284	SMD 2K2 0.1W 5% RES 0805 (TRS)	940-2220501
R286	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R287	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R288	SMD 330R 0.1W 5% RES 0805 (TRS)	940-3310501
R289	SMD 150R 0.1W 5% RES 0805 (TRS)	940-1510501
R290	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R291	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R292	SMD 180R 0.1W 5% RES 0805 (TRS)	940-1810501
R293	SMD 1K2 0.1W 5% RES 0805 (TRS)	940-1220501
R294	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R295	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R296	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R297	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R298	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R299	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501

R300	SMD 2K 0.1W 5% RES 0805 (TRS)	940-2020501
R301	SMD 270R 0.1W 1% RES 0805 TR	940-2710101
R302	SMD 1K 0.1W 1% RES 0805 (TRS)	940-1020101
R303	SMD 1K 0.1W 1% RES 0805 (TRS)	940-1020101
R304	SMD 150R 0.1W 5% RES 0805 (TRS)	940-1510501
R305	SMD 1K1 0.1W 1% RES 0805 (TRS)	940-1120101
R307	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501
R308	SMD 330R 0.1W 5% RES 0805 (TRS)	940-3310501
R309	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R310	SMD 6K2 0.1W 5% RES 0805 (TRS)	940-6220501
R311	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501
R312	SMD 390R 0.1W 5% RES 0805 (TRS)	940-3910501
R313	SMD 180R 0.1W 5% RES 0805 (TRS)	940-1810501
R314	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R315	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R316	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R317	SMD 8K2 0.1W 1% RES 0805 (TRS)	940-8220101
R318	SMD 33K 0.1W 5% RES 0805 (TRS)	940-3330501
R319	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R320	SMD 33R 0.1W 5% RES 0805 (TRS)	940-3300501
R321	SMD 43R 0.1W 5% RES 0805 (TR)	940-4300501
R327	SMD 680R 0.1W 1% RES 0805 (TRS)	940-6810101
R328	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R329	SMD 2K2 0.1W 5% RES 0805 (TRS)	940-2220501
R330	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R331	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R332	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501
R333	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R335	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R336	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R337	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R338	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R339	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R340	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501
R341	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501
R342	SMD 270R 0.1W 5% RES 0805 (TRS)	940-2710501
R343	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501
R344	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R345	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R346	SMD 270R 0.1W 5% RES 0805 (TRS)	940-2710501
R347	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R348	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501
R349	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R350	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R351	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R353	SMD 330R 0.1W 5% RES 0805 (TRS)	940-3310501
R354	SMD 330R 0.1W 5% RES 0805 (TRS)	940-3310501
R355	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R356	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R357	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R358	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R359	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R360	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R361	SMD 6K2 0.1W 5% RES 0805 (TRS)	940-6220501
R362	SMD 56R 0.1W 5% RES 0805 (TRS)	940-5600501
R363	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R364	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R368	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R369	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R370	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R371	SMD 220K 0.1W 5% RES 0805 (TRS)	940-2240501
R372	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R373	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R374	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R375	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R376	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501

SPARES - ELECTRICAL PARTS LISTS FOR MAIN BOARD (cont.)

R377	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R378	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R379	SMD 390R 0.1W 5% RES 0805 (TRS)	940-3910501
R380	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R381	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R382	SMD 39K 0.1W 5% RES 0805 (TRS)	940-3930501
R383	SMD 15K 0.1W 5% RES 0805 (TRS)	940-1530501
R385	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R386	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R387	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R389	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R390	SMD 2K7 0.1W 5% RES 0805 (TRS)	940-2720501
R392	47K 3W 5% 17.5MM FLAME RETARDANT MOR-3W	148-4738501
R396	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R414	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R415	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R416	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R422	SMD 2K2 0.1W 5% RES 0805 (TRS)	940-2220501
R438	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R439	4R7 0.25W 5% CARBON FILM RES TR	140-0472501
R440	1K5 0.25W 1% METAL FILM RES TR	141-1522101
R442	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R443	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R444	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R445	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R446	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R447	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R448	SMD 22K 0.1W 5% RES 0805 (TRS)	940-2230501
R449	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R450	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R451	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R452	SMD 1R8 0.1W 5% RES 0805 (TRS)	940-0180501
R454	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R455	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R457	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R458	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R459	SMD 1K 0.1W 1% RES 0805 (TRS)	940-1020101
R460	SMD 1K 0.1W 1% RES 0805 (TRS)	940-1020101
R461	4R7 0.25W 5% CARBON FILM RES TR	140-0472501
R462	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R463	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R465	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R467	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R474	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R475	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501
R476	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R477	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R478	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R479	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R480	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R481	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R482	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R483	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R484	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R485	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R486	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R488	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R491	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R492	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R493	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R494	SMD 560R 0.1W 5% RES 0805 (TRS)	940-5610501
R496	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R497	SMD 1M 0.1W 5% RES 0805 (TRS)	940-1050501
R499	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R500	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R501	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R502	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R503	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R504	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R505	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R506	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R507	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R509	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R511	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R512	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R514	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R515	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R518	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R519	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R521	SMD 680R 0.1W 5% RES 0805 (TRS)	940-6810501
R522	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R523	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R526	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R527	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R528	SMD 3K3 0.1W 5% RES 0805 (TRS)	940-3320501
R529	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R530	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R531	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R532	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R533	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R534	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R535	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R536	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R539	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R540	SMD 3K9 0.1W 5% RES 0805 (TRS)	940-3920501
R541	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R542	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R543	SMD 12K 0.1W 5% RES 0805 (TRS)	940-1230501
R544	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R545	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R547	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R548	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R549	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R550	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R551	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R552	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R555	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R557	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R559	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R560	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R562	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R563	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R564	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R566	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R567	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R568	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R569	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R571	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R573	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R586	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R588	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R589	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R592	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R593	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R598	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R599	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R600	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R601	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
R602	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R603	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R606	SMD 270R 0.1W 5% RES 0805 (TRS)	940-2710501

SPARES - ELECTRICAL PARTS LISTS FOR MAIN BOARD (cont.)

Integrated Circuits

U1	SL5066 VIDEO MODULATOR (PLESSEY)	109-0506601
U2	SP4633 SO PRESCALER (PLESSEY)	109-0463301
U3	TEA2018 SWITCH MODE PSU (THOMSON)	109-0201801
NOTE:	U4 is replaced by U4 extension PCB (see below)	
U5	SMD IC-74HC4052 (TR)	902-1405201
U6	74LS47	101-0004700
U7	24C32 32K EE	104-0243200
U8	(A VIDEOCRYPT COMPONENT)	109-0011001
U9	(A VIDEOCRYPT COMPONENT)	109-0011401
U10	(A VIDEOCRYPT COMPONENT)	109-0011201
U11	(A VIDEOCRYPT COMPONENT)	109-0011501
U12	(A VIDEOCRYPT COMPONENT)	109-0011101
U13	(A VIDEOCRYPT COMPONENT)	109-0011301
U14	SOUND PROCESSOR MSP3400 "64 PIN DIL"	109-0340000
U15	SMD IC-74HC04 (TR)	902-2000401
U16	NICKY ASIC 3	109-0960103
U17	M35010-001SP DISPLAY CONT (MISUBISHI)	109-0350100
U18	SMD IC-74HC4053 (TR)	902-1405301
U20	SMD IC-4053 SO-16 TR	906-0405302
U21	SMD IC-74HC4052 (TR)	902-1405201
U22	SMD IC-74LS74 (TR)	901-1007401
U26	CD4094BCN 8 BIT SHIFT AND STORE REGISTER	106-0409400

Miscellaneous Components

CARD1	SMART CARD READER-ALCATEL7001LM0416T2F08	870-7001001
FIT TO U4:		
2 OFF	SOCKET 20 WAY TOP ENTRY (HARWIN)	161-2002001
FIT TO FS1:		
2 OFF	FUSECLIP-PFC5000-0202 (SMK)	201-7500001
FS1 ⚠	*A* FUSE F1AL 20 X 5MM GLASS FAST BLOWN	201-2521000
IR1	SONY INFRA-RED REC MODULE (SBX 1620-E2)	215-1620002
LED1	3-UNIT 7-SEG DISPLAY GREEN	200-7030102
MOD1	MODULATOR SCREENING CAN-FRAME REV I	315-0235102
SW1 B	SWITCH-B3F3152 PCB SUBMIN 150GM (YELLOW)	204-0315211
SW2	SWITCH-B3F3152 PCB SUBMIN 150GM (YELLOW)	204-0315211
SW3	SWITCH-B3F3152 PCB SUBMIN 150GM (YELLOW)	204-0315211
SW4 B	SWITCH-B3F3152 PCB SUBMIN 150GM (YELLOW)	204-0315211
T1	MAINS FILTER-(UF2327S-253-YOR5) "TDK"	232-2327000
T2 ⚠	*A* TRANSFORMER-SM MSS200/300 SERIES	237-0400006
TST1	TEST PIN-VIDEOCRYPT	161-1000100
TUNER1	PACE PC77G01 2GHZ S/LNB FIXED 'F'TUNER	221-2077012
W1A	TEST PIN-VIDEOCRYPT	161-1000100
X2	XTAL 28MHZ HC18U 50/100/-20/30PF PAR 3RD	170-0280000
X3	RESONATOR-503KHZ TYPE CSB503F21	171-0005030
X4	XTAL 18.432MHZ HC18U 40/40/10/ 10PF PAR	170-0184320
X5	CERAMIC TRAP TPS 4.43MJ	176-0044301
X6	XTAL 17.734MHZ HC49U 20/30/10 10PF PAR	170-0177341

Retrofitted Components

Resistor fitted in parallel with L33 (PCO 000309):	
2K2 0.25W 5% CARBON FILM RES TR	140-2222501
Capacitor fitted between pins 5 and 14 of U16 to prevent UHF glitching by improving the phase lock of the modulator:	
390PF 100V 5% CERAMIC CAP TR	150-3917551
Mod. wire fitted between LK203 and R251:	
MOD WIRE-0.5 X 50MM (INS LENGTH) RED	190-0505015

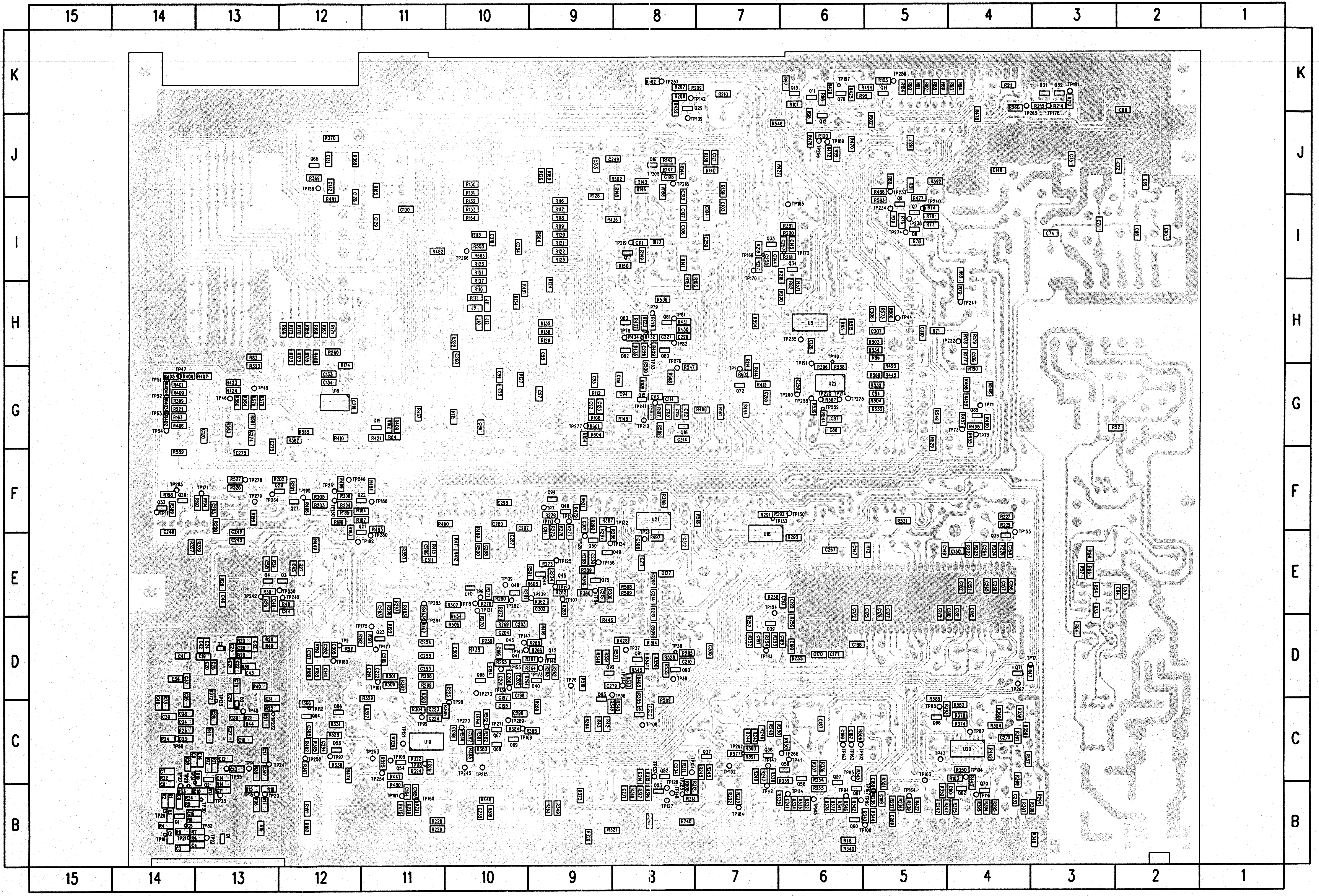
SPARES - ELECTRICAL PARTS LIST FOR U4 EXTENSION BOARD

C1	1UF 50V 5MM M/LAYER CER.CAP TR	157-1055751
C2	100NF 50V 5MM M/LAYER CER.CAP TR	157-1045751
C3	100NF 50V 5MM M/LAYER CER.CAP TR	157-1045751
C4	100NF 50V 5MM M/LAYER CER.CAP TR	157-1045751
C5	33PF 16V 5MM CERAMIC CAP 10% TR	150-3301651
C6	47PF 50V 5% CERAMIC CAP TR	150-4705551
J1	TINNED COPPER WIRE LINKS 0.61MM DIA-PMF	999P1099901
PL 1	PIN HEADER-20 WAY EXTENDED S/ROW(SAMTEC)	161-1002002
Note: 2 of these connectors are fitted to make up PL1		
U1	SMD IC-Z86C9620VSC ROMLESS Z8	904-0869601
U3	74HC374	102-1037400
U4	EPROM-27256 MSS201-I ENG V2 (805-0200105)	805-0200105
FIT TO U4		
	SOCKET-28 PIN IC DIL	209-2002800
X1	XTAL 16MHZ HC18U 50/50/-10+60 30PF PAR	170-0160000
FIT TO X1		
	INS.WASHER-FOR HC18/49 (HOLED) XTAL CAN	208-0153000

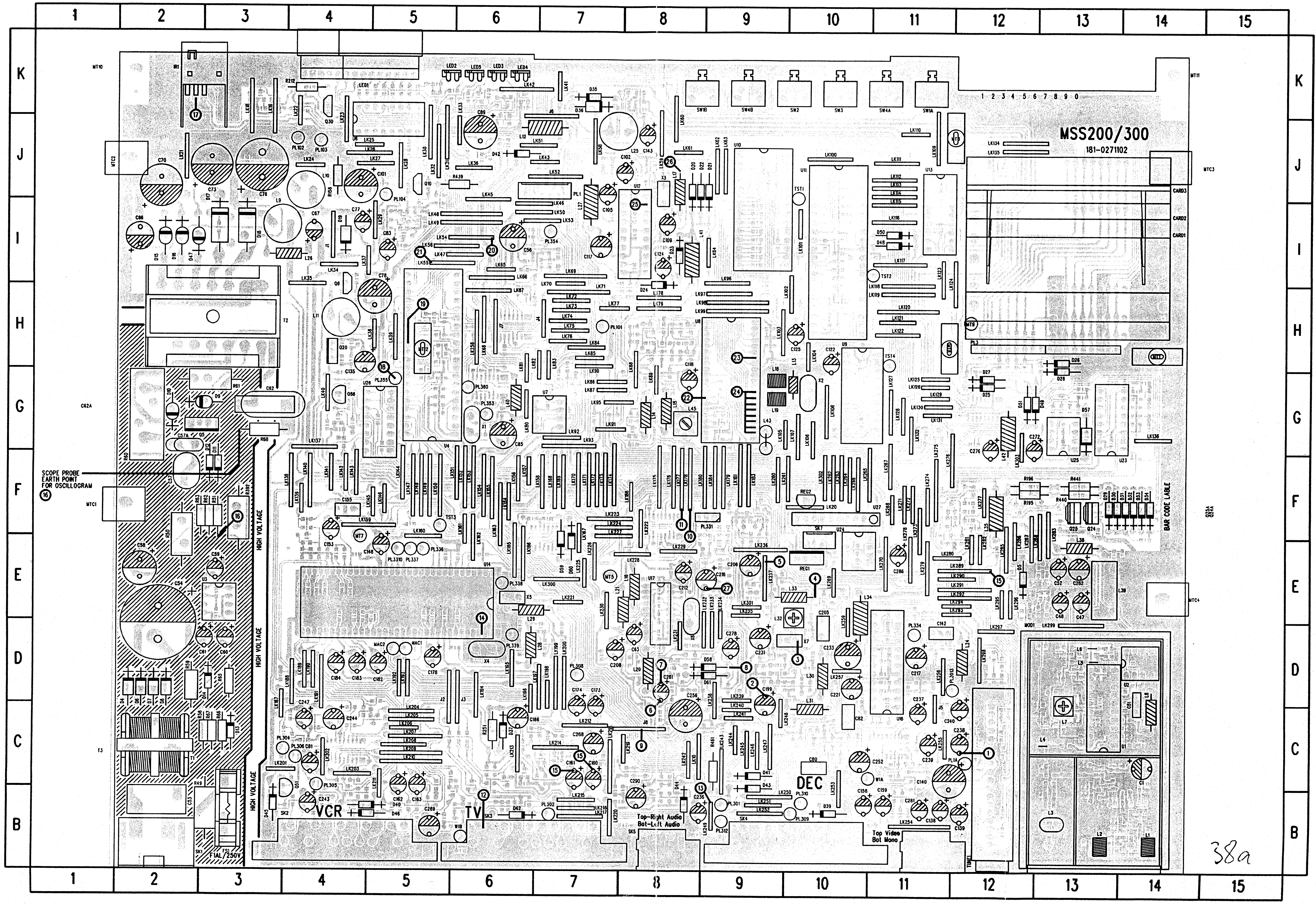
SPARES - MECHANICAL PARTS LIST

1 OFF	ADDENDUM SHEET FOR MSS200-I MANUAL	504-2010105
1 OFF ⚠	*A* MAINS CABLE UK "8" (NO PLUG) 1.8M	191-1015280
1 OFF ⚠	*A*MANUAL MSS200-I S/LNB PAL-I PACE	502-2010100
1 OFF ⚠	*A*MSS200-I BAR CODE LAB"E" (721-1000100)	297-1006800
1 OFF ⚠	*A*START-UP GUIDE - MSS200-I MANUAL	505-2010100
1 OFF	BAG-POLYTHENE 20X17" FOR MSS1000 UNIT	400-1201700
1 OFF	BASE - MSS200/300 UNIVERSAL	321-3000100
2 OFF	BATTERY-1.5V AAA	239-0015000
1 OFF	BLANKING GROMMET FOR S/LNB OPTION	306-7890000
4 OFF	BUMPON-SJ5003 SMALL BLACK DOME	208-5003010
1 OFF	CABLE-COAX UHF MALE TO FEMALE	198-0015021
1 OFF	CARDBOARD INTERNAL FITMENT MSS200/300	444-2300000
1 OFF	CARTON-MSS200 SERIES PACE PRINTED	412-2300100
1 OFF	COVER - MSS200 SERIES (PRE-PAINTED)	312-2000000
1 OFF	FSSA/B-INSTALL SHEET ISSUE3 UNBRANDED	504-8661027
1 OFF	HALF NUT-3/8 FORM 32 TOI.2A	240-1380011
2 OFF	MODULATOR SCREENING CAN-TOP REV I	315-0235001
1 OFF	MSS200-I FRONT PANEL	360-2011100
1 OFF	MSS SERIES HANDSET PACE BRANDED	699-1000101
1 OFF	PAPER WIRE TIE-4"	206-0040000
2 OFF	PILLAR-LCBS-14 (RICHCO)	248-0014002
2 OFF	PILLAR-SP1-6-01 STAND-OFF (RICHCO)	248-1601001
2 OFF	PLASTITE SCREW-4 X 1/4 POZI PAN BLACK	245-4140011
1 OFF	PROG LIST SHEET-MSS1000 V/CRYPT UK PACE	504-1010101
6 OFF	SCREW-M3 X 8 P/P TAP.C/W WASHER BLK SEAL	246-3080011
4 OFF	SNAP RIVET-SR3555B BLACK PLASTIC RICHCO	247-3555111

MAIN BOARD IDENT DIAGRAM - SURFACE MOUNT SIDE


15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
K
J
I
H
G
F
E
D
C
B

MAIN BOARD IDENT DIAGRAM - COMPONENT SIDE


MSS200/300
181-0271102
SCOPE PROBE EARTH POINT FOR OSCILLOGRAM
HIGH VOLTAGE
VCR
TV
DEC
Top-Right Audio
Bot-Left Audio
Top Video
Bot Mono
BAR CODE LABLE
F1AL/250V
CARD1
CARD2
CARD3
MTC1
MTC2
MTC3
MTC4
T2
T3
U4
U14
SW1A
SW1B
SW2
SW3
SW4A
SW4B
1 2 3 4 5 6 7 8 9 0
K J I H G F E D C B
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

38a

GAINING ACCESS TO THE UNIT

REMEMBER - SAFETY FIRST

WARNING: Always disconnect the unit from the mains supply before dismantling it.

WARNING: Remove your wrist strap before applying power to the re-assembled equipment to avoid potential shock hazards.

WARNING: The incorrect substitution of electrolytic capacitors may result in an explosion hazard.

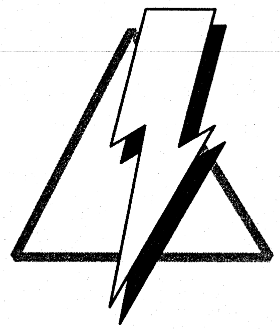
CAUTION: Work on an earth mat and wear a wrist strap and earth lead to prevent electrostatic damage to components. Once the main board is removed from the casing it is fairly flexible, so handle it carefully to avoid damaging the components.

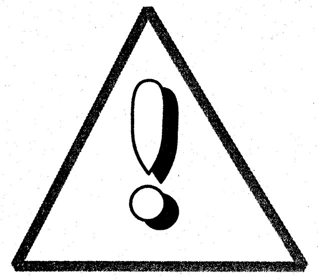
CAUTION: You must replace all the PCB fixings, screws etc. when the unit is re-assembled, otherwise there could be hazards due to reduced clearances.

CAUTION: Before you apply mains power to the unit, always ensure that the voltage rating stated on the rear panel of the unit matches the mains voltage supply in the country of installation.

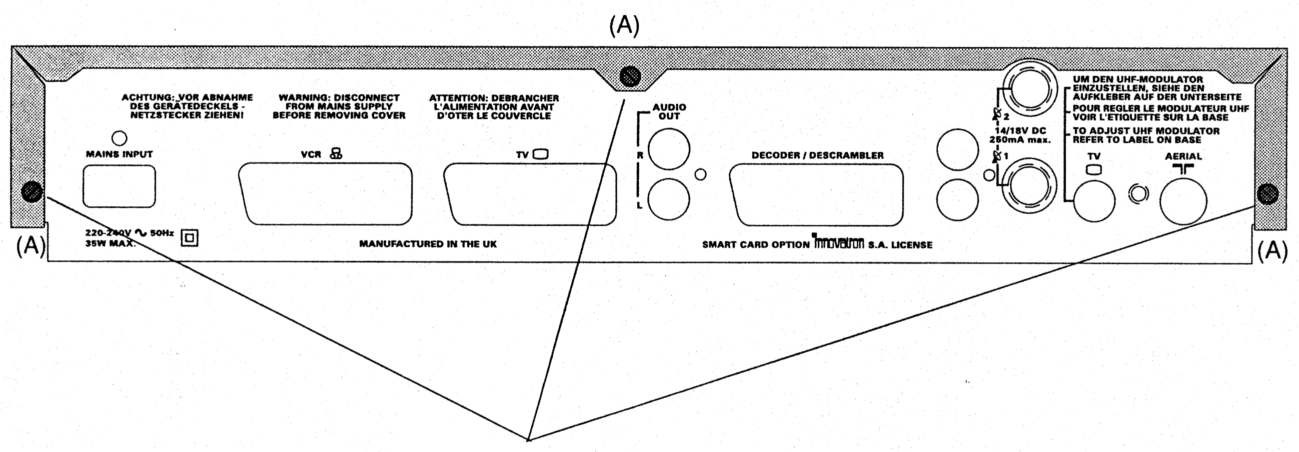
CAUTION: Do not spray chemicals on or near the unit.

CAUTION: Replacements for faulty components must be of the correct value and rating and must be assembled by a competent service engineer, otherwise safety approvals could be invalidated.





REMOVING THE COVER

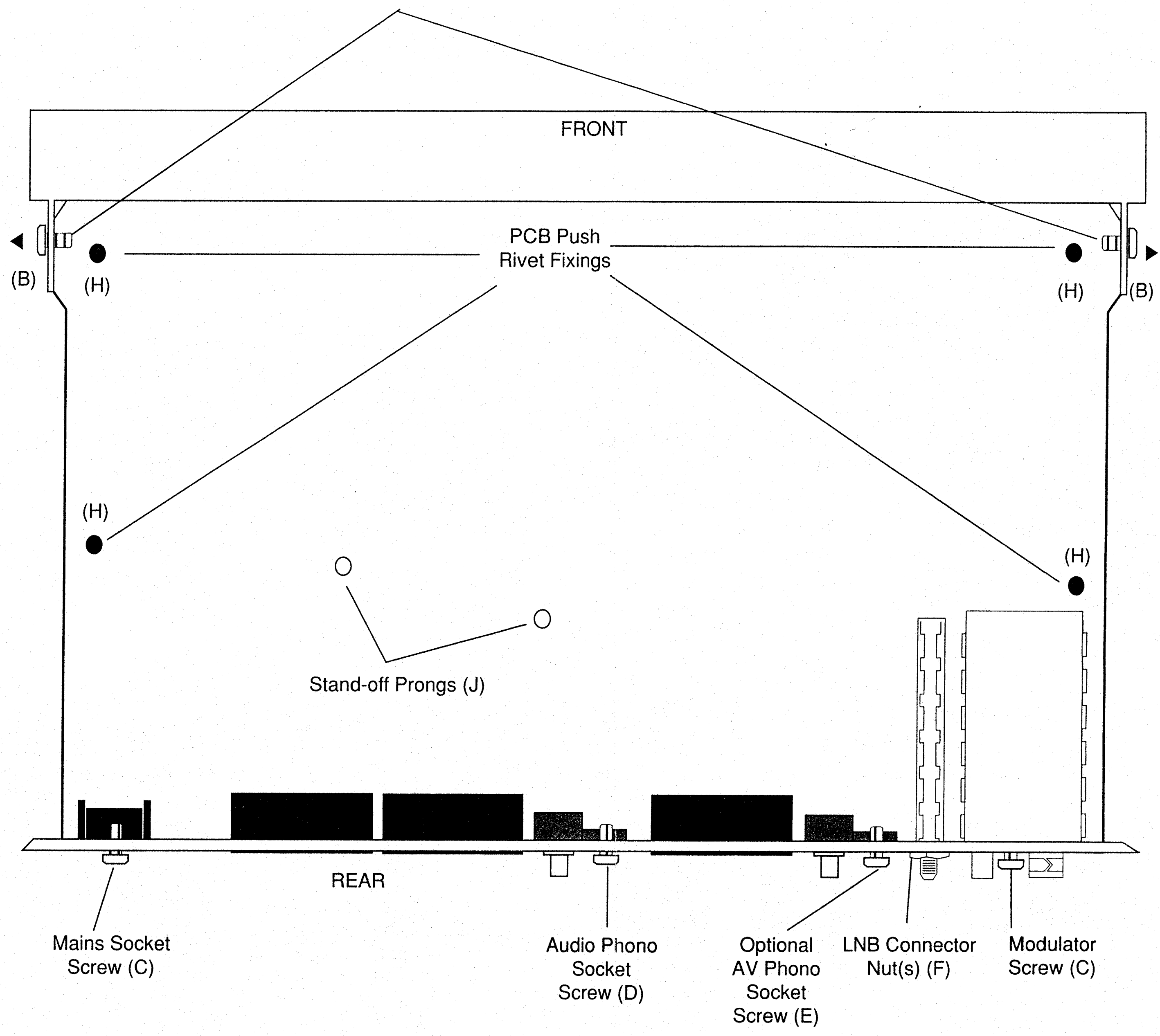

(A)
(A)
(A)
ACHTUNG: VOR ABNAHME DES GERÄTEDECKELS - NETZSTECKER ZIEHEN!
WARNING: DISCONNECT FROM MAINS SUPPLY BEFORE REMOVING COVER
ATTENTION: DEBRANCHER L'ALIMENTATION AVANT D'OTER LE COUVERCLE
MAINS INPUT
VCR
TV
AUDIO OUT
R
L
DECODER / DESCRAMBLER
2
14/18V DC
250mA max.
1
UM DEN UHF-MODULATOR EINZUSTELLEN, SIEHE DEN AUFKLEBER AUF DER UNTERSEITE
POUR REGLER LE MODULATEUR UHF VOIR L'ETIQUETTE SUR LA BASE
TO ADJUST UHF MODULATOR REFER TO LABEL ON BASE
TV
AERIAL
220-240V ∿ 50Hz
35W MAX.
MANUFACTURED IN THE UK
SMART CARD OPTION Innovatron S.A. LICENSE

Remove the 3 taptite screws (A) and slide the cover towards the rear.

REMOVING THE FRONT PANEL AND MAIN BOARD

To remove the front panel:

Unscrew the screws (B) at the sides of the unit. Carefully unhook the front panel's side straps from their chassis retaining-clips, then pull the front panel away.


FRONT
PCB Push Rivet Fixings
(B)
(H)
(H)
(B)
(H)
(H)
Stand-off Prongs (J)
REAR
Mains Socket Screw (C)
Audio Phono Socket Screw (D)
Optional AV Phono Socket Screw (E)
LNB Connector Nut(s) (F)
Modulator Screw (C)

To remove the main board:

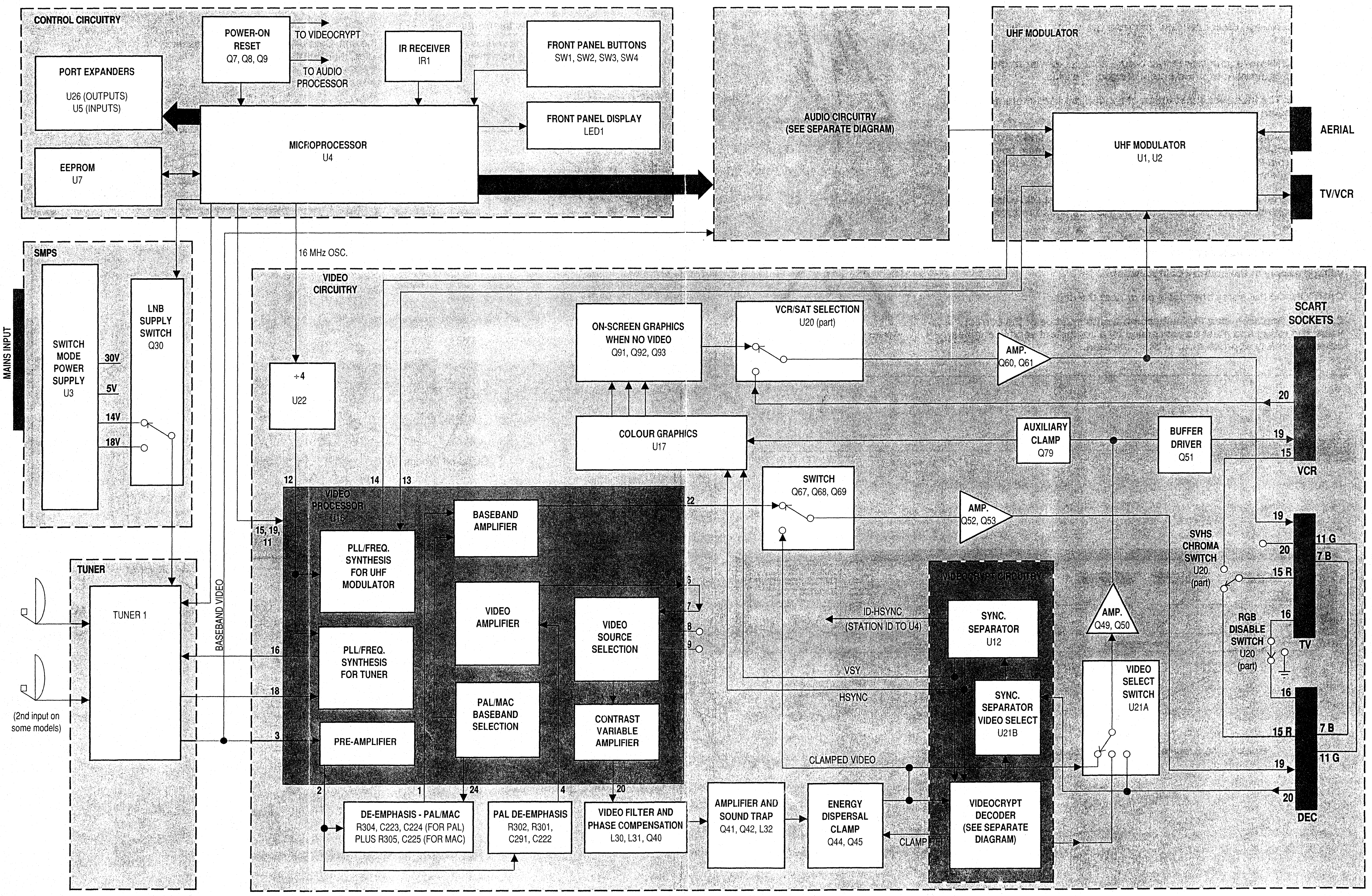
Unscrew the rear-panel screws C, D, E (if present) and G. Use a nut runner to remove the nut(s) (F) from the LNB connector.

Remove the 4 push rivets (H) at the edges of the main board.

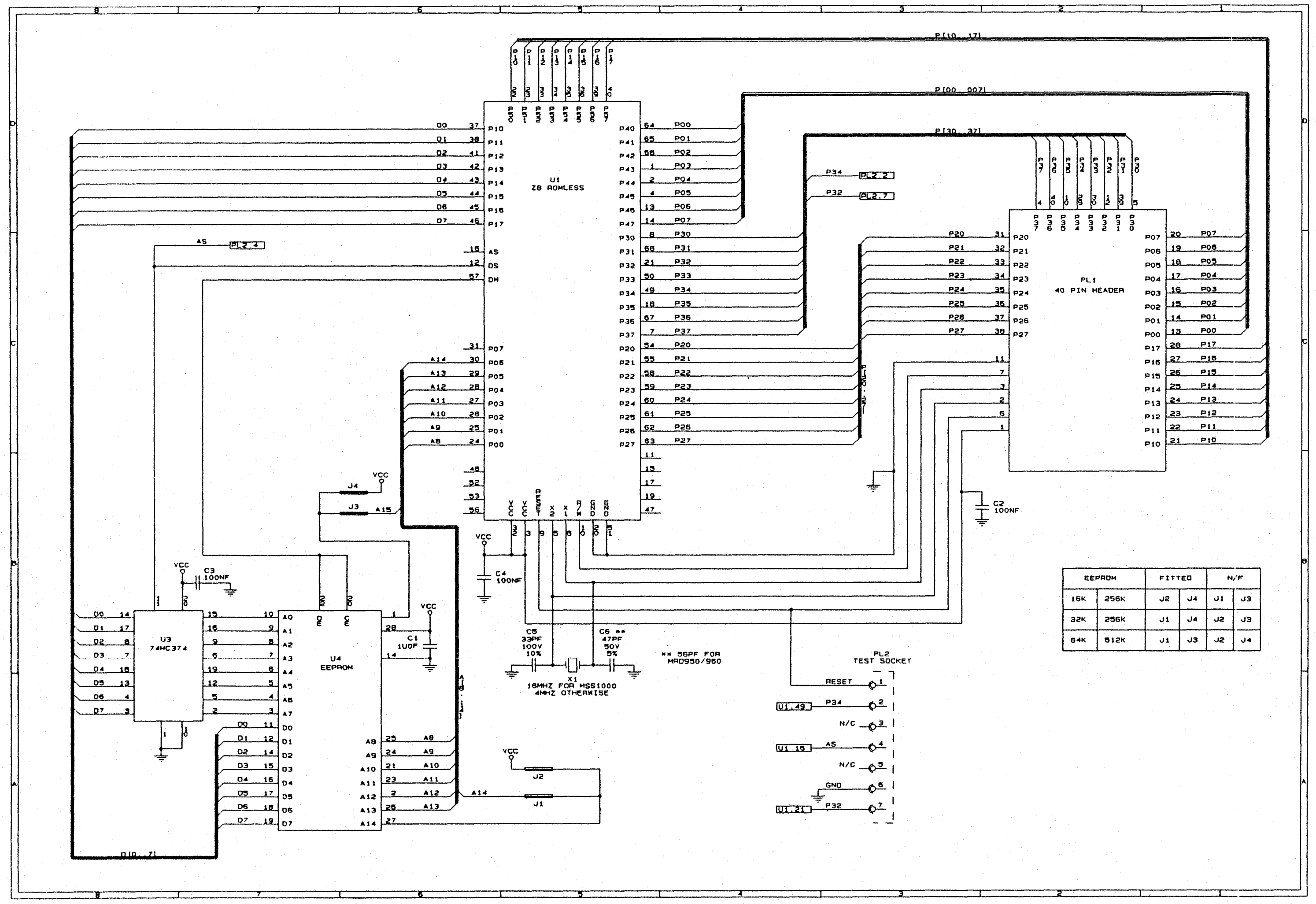
To free the PCB, lift the front edge of the board, and, while doing so, crimp together the stand-off prongs (J) (near the middle of the board) using tweezers.

Gently slide the PCB away from the rear panel.

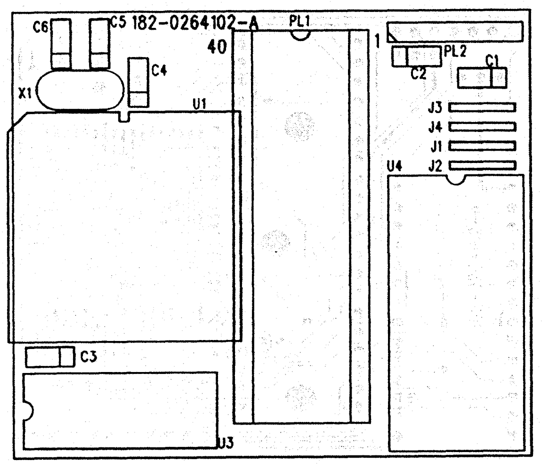
MAIN BLOCK DIAGRAM


CONTROL CIRCUITRY
POWER-ON RESET
Q7, Q8, Q9
TO VIDEOCRYPT
TO AUDIO PROCESSOR
IR RECEIVER
IR1
FRONT PANEL BUTTONS
SW1, SW2, SW3, SW4
PORT EXPANDERS
U26 (OUTPUTS)
U5 (INPUTS)
FRONT PANEL DISPLAY
LED1
MICROPROCESSOR
U4
EEPROM
U7
AUDIO CIRCUITRY
(SEE SEPARATE DIAGRAM)
UHF MODULATOR
UHF MODULATOR
U1, U2
AERIAL
TV/VCR
SMPS
MAINS INPUT
SWITCH MODE POWER SUPPLY
U3
30V
5V
14V
18V
LNB SUPPLY SWITCH
Q30
16 MHz OSC.
VIDEO CIRCUITRY
÷4
U22
ON-SCREEN GRAPHICS WHEN NO VIDEO
Q91, Q92, Q93
VCR/SAT SELECTION
U20 (part)
AMP.
Q60, Q61
SCART SOCKETS
COLOUR GRAPHICS
U17
AUXILIARY CLAMP
Q79
BUFFER DRIVER
Q51
20
19
15
VCR
12
14
13
VIDEO PROCESSOR
U16
15, 19, 11
PLL/FREQ. SYNTHESIS FOR UHF MODULATOR
BASEBAND AMPLIFIER
22
SWITCH
Q67, Q68, Q69
AMP.
Q52, Q53
19
SVHS CHROMA SWITCH
U20
(part)
20
11 G
7 B
15 R
TUNER
TUNER 1
(2nd input on some models)
BASEBAND VIDEO
16
18
3
VIDEO AMPLIFIER
VIDEO SOURCE SELECTION
6
7
8
9
PLL/FREQ. SYNTHESIS FOR TUNER
ID-HSYNC
(STATION ID TO U4)
VIDEOCRYPT CIRCUITRY
SYNC. SEPARATOR
U12
AMP.
Q49, Q50
RGB DISABLE SWITCH
U20
(part)
16
TV
VSY
HSYNC
SYNC. SEPARATOR VIDEO SELECT
U21B
VIDEO SELECT SWITCH
U21A
16
15 R
7 B
11 G
PAL/MAC BASEBAND SELECTION
CONTRAST VARIABLE AMPLIFIER
PRE-AMPLIFIER
CLAMPED VIDEO
19
20
DEC
2
1
24
4
20
DE-EMPHASIS - PAL/MAC
R304, C223, C224 (FOR PAL)
PLUS R305, C225 (FOR MAC)
PAL DE-EMPHASIS
R302, R301, C291, C222
VIDEO FILTER AND PHASE COMPENSATION
L30, L31, Q40
AMPLIFIER AND SOUND TRAP
Q41, Q42, L32
ENERGY DISPERSAL CLAMP
Q44, Q45
CLAMP REF
VIDEOCRYPT DECODER
(SEE SEPARATE DIAGRAM)

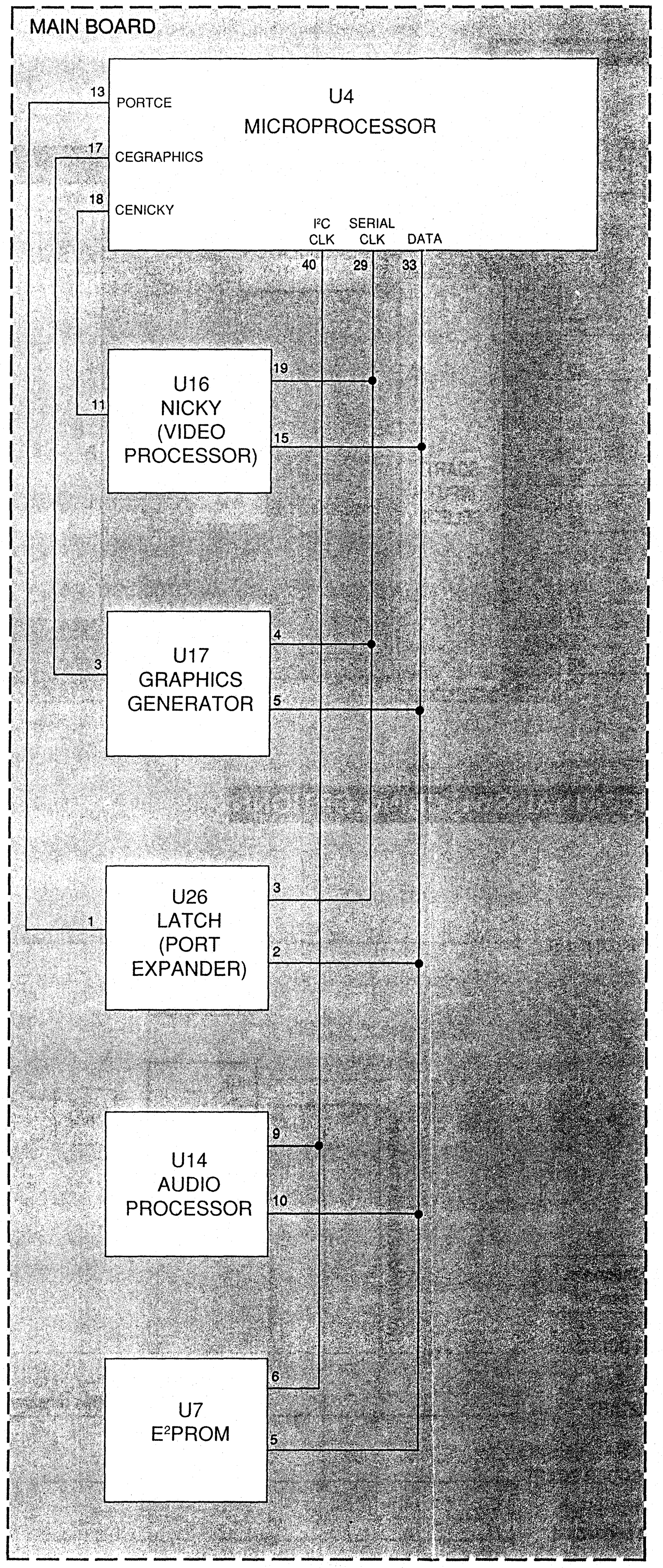
CIRCUIT AND COMPONENT IDENT DIAGRAMS FOR U4 EXTENSION PCB


U1
Z8 ROMLESS
U3
74HC374
U4
EEPROM
PL1
40 PIN HEADER
P[10..17]
P[00..007]
P[30..37]
D[0..7]
C1
10UF
C2
100NF
C3
100NF
C4
100NF
C5
33PF
100V
10%
C6 **
47PF
50V
5%
X1
16MHZ FOR MSS1000
4MHZ OTHERWISE
** 56PF FOR
MAD950/960
PL2
TEST SOCKET
RESET
P34
N/C
AS
GND
P32
U1,49
U1,16
U1,21
VCC
J1
J2
J3
J4
A14
A15
VCC
VCC
X2
X1
R/W
GND
GND

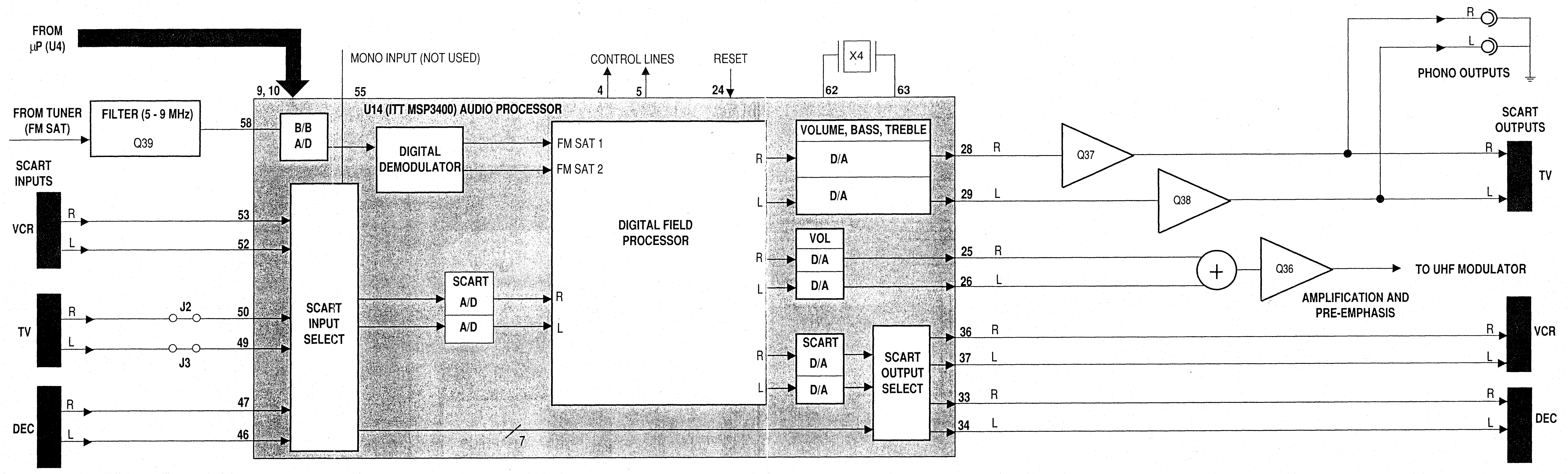
EEPROM		FITTED		N/F	
16K	256K	J2	J4	J1	J3
32K	256K	J1	J4	J2	J3
64K	512K	J1	J3	J2	J4


C6
C5
182-0264102-A
40
PL1
1
PL2
C2
C1
C4
X1
U1
J3
J4
J1
J2
U4
C3
U3

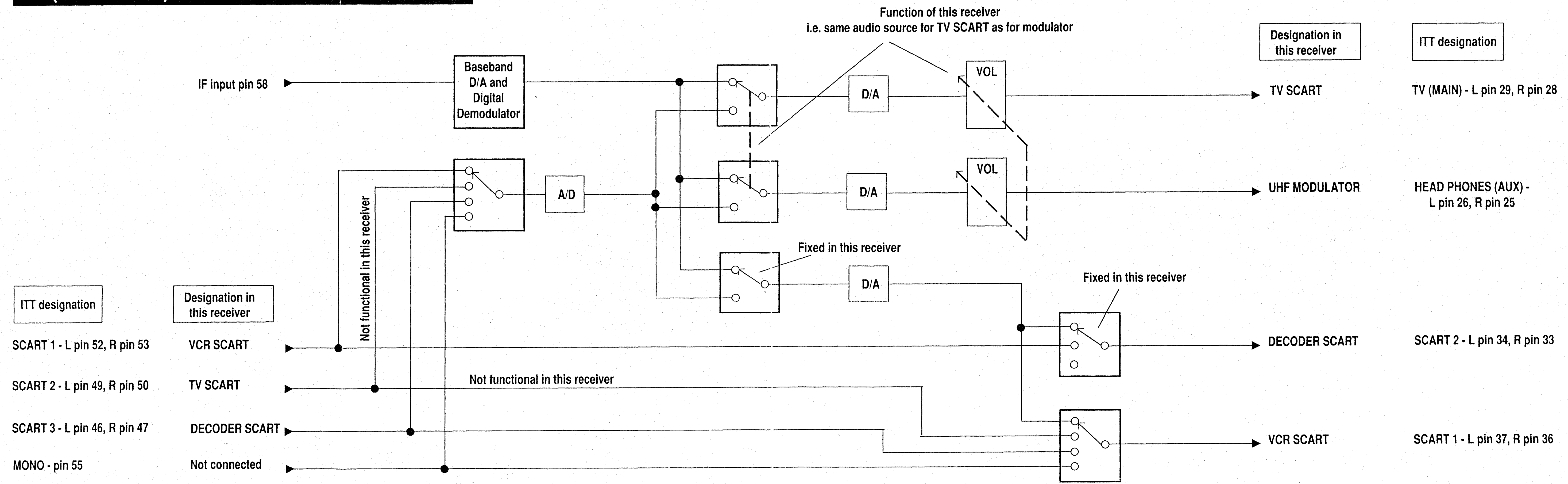
BLOCK DIAGRAM OF CLOCK AND DATA CONTROL LINES


MAIN BOARD
U4
MICROPROCESSOR
13
PORTCE
17
CEGRAPHICS
18
CENICKY
I²C
CLK
SERIAL
CLK
DATA
40
29
33
U16
NICKY
(VIDEO
PROCESSOR)
19
11
15
U17
GRAPHICS
GENERATOR
4
3
5
U26
LATCH
(PORT
EXPANDER)
3
1
2
U14
AUDIO
PROCESSOR
9
10
U7
E²PROM
6
5

AUDIO BLOCK DIAGRAM


FROM
µP (U4)
MONO INPUT (NOT USED)
CONTROL LINES
RESET
X4
PHONO OUTPUTS
R
L
FROM TUNER
(FM SAT)
FILTER (5 - 9 MHz)
Q39
9, 10
55
4
5
24
62
63
U14 (ITT MSP3400) AUDIO PROCESSOR
58
B/B
A/D
DIGITAL
DEMODULATOR
FM SAT 1
FM SAT 2
DIGITAL FIELD
PROCESSOR
VOLUME, BASS, TREBLE
D/A
D/A
VOL
D/A
D/A
SCART
D/A
D/A
SCART
OUTPUT
SELECT
SCART
INPUTS
VCR
TV
DEC
53
52
50
49
47
46
J2
J3
SCART
INPUT
SELECT
SCART
A/D
A/D
7
28
29
25
26
36
37
33
34
Q37
Q38
Q36
AMPLIFICATION AND
PRE-EMPHASIS
TO UHF MODULATOR
SCART
OUTPUTS
TV
VCR
DEC

U14 (ITT MSP3400) FUNCTIONAL SWITCHING OPTIONS


Function of this receiver
i.e. same audio source for TV SCART as for modulator
Designation in
this receiver
ITT designation
IF input pin 58
Baseband
D/A and
Digital
Demodulator
D/A
VOL
TV SCART
TV (MAIN) - L pin 29, R pin 28
A/D
D/A
VOL
UHF MODULATOR
HEAD PHONES (AUX) -
L pin 26, R pin 25
Not functional in this receiver
Fixed in this receiver
D/A
Fixed in this receiver
ITT designation
Designation in
this receiver
SCART 1 - L pin 52, R pin 53
VCR SCART
SCART 2 - L pin 49, R pin 50
TV SCART
SCART 3 - L pin 46, R pin 47
DECODER SCART
MONO - pin 55
Not connected
Not functional in this receiver
DECODER SCART
SCART 2 - L pin 34, R pin 33
VCR SCART
SCART 1 - L pin 37, R pin 36

ADDENDUM SHEET FOR THE MSS 200-I SERVICE MANUAL

THIS ADDENDUM SHEET IS FOR USE WITH THE MSS 200-I SERVICE MANUAL (PART NO.: 503-2000100). IT COVERS THE DIFFERENCES (AT 11.11.94) BETWEEN THE MSS 200-I AND OTHER RECEIVERS IN THE MSS 200 AND MSS 300 SERIES.

The main differences between the MSS 200 series and MSS 300 series are:

	MSS 200 series			MSS 300 series		
	MSS 200-I	**MSS 232-G**	**MSS 248-GR**	**MSS 301-I**	**MSS 334-G**	**MSS 348-GR**
VideoCrypt	Yes	No	No	Yes	No	No
C-band	No	Yes	Yes	No	Yes	Yes
Tuner bandwidth	27 MHz	18/27 MHz	15/27 MHz	27 MHz	18/27 MHz	15/27 MHz
Number of progs.	199	199	199	250	250	250
LNB input	Single	Single	Dual	Dual	Dual	Dual
Display	LED	LED	LED	VFD	VFD	VFD
AV phono sockets	No	No	Yes	No	No	Yes
Polariser	No	No	Yes	No	No	Yes

Note the following:

- Receivers with dual LNB inputs have additional components in the LNB select and supply circuitry.
- Receivers with a vacuum fluorescent display (VFD) have a separate display PCB which is mounted inside the front panel of the receiver. The display board is currently at Revision A1 and is described in detail starting on page 5 of this addendum.
- MSS 248-GR and MSS 348-GR have additional components fitted for the extra AV phono sockets and for the polariser (see pages 10 and 11).
- Non-VideoCrypt receivers have different components for their own sync. separator circuitry (see page 10). They have a hand modification to the main PCB (which is at Revision A2) to allow the horizontal sync. pulses to reach the microprocessor U4, as these provide the "station ID" for non-VideoCrypt receivers (see page 4). This modification means that R87 has a different value and that R592 and LK84 are not fitted for non-VideoCrypt receivers.
- C29 has a different value for non-VideoCrypt receivers as it determines whether the receiver is PAL I or PAL G.
- C126 is a zerohm link for the non-VideoCrypt receivers; this keeps the VC_STATUS line permanently low.
- Certain components shown in the VideoCrypt circuit diagram need to be fitted for non-VideoCrypt receivers. R42, R43 and LK228 provide biasing for an external decoder. R369 (a zerohm link) and R370 are pull-down resistors. L41 is a wire link for non-VideoCrypt receivers. For the MSS 248-GR and MSS 348-GR, L42 is fitted.
- By 11.11.94, the MSS 200-I had had its masked microprocessor U4 fitted (see page 12 of this sheet) whereas the other models still contain a U4 extension PCB. This means that, currently, X1, C86 and C87 are only fitted on the MSS 200-I, and that on the other models R593 still retains its old value.
- There are also various mechanical differences between the models; lists of the differences are given on page 3.

The parts lists and circuit diagrams in this sheet include information from all Engineering Change Orders (ECOs) up to and including ECO S000861 and all Production Change Orders (PCOs) up to and including PCO S000405, provided that these ECOs and PCOs had an effectivity date on or before 11.11.94.

Page 12 of this addendum gives changes which have occurred in the MSS 200-I since the main service manual (Part no: 503-2000100) went to print (i.e. changes between 17.08.94 and 11.11.94). Many of these changes also apply to the other models; note that the parts lists comparisons given on page 4 compare the status at 11.11.94.

Further changes will be given in technical bulletins or further addendum sheets until the main manual is re-issued.

ERRORS IN MSS 200-I SERVICE MANUAL (PART NO: 503-2000100)

The following minor errors in the MSS 200-I manual should be corrected as follows:

In the Outline Specification (page 4) the LNB tone switching frequency should be 22 kHz ±2 kHz.

The LEVEL key on the handset (page 6) can be used to display the preset volume level.

"Setting the Positioner Pol. Option" (page 10) applies only to certain MSP995 positioners and the MSP200.

In the diagram on page 15, the direct connection between pin 1 of U16 and C224 should be removed.

Contrast setting at the Picture Menu (page 16) must be between 3 and 7 for optimal VideoCrypt operation.

References on pages 23 and 24 to the control line IN/EXT should read INT/EXT.

In the description of the oscillogram at Test Point 20 (page 32), the three buttons are labelled ⏻, ▲ and ▼.

PACE

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504-2000101

SOFTWARE AND OTHER DIFFERENCES

IN THE OUTLINE SPECIFICATION

GENERAL

Number of Programmes	250 (MSS 300 series); 199 (MSS 200 series)
Front Panel Control	There is a shape button instead of the authorise button (MSS 300 series) There is no authorise button (MSS 232-G and MSS 248-GR)
UHF Modulator	CCIR PAL System I (MSS 200-I and MSS 301-I) CCIR PAL System G (MSS 232-G, MSS248-GR, MSS 334-G, MSS 348-GR)

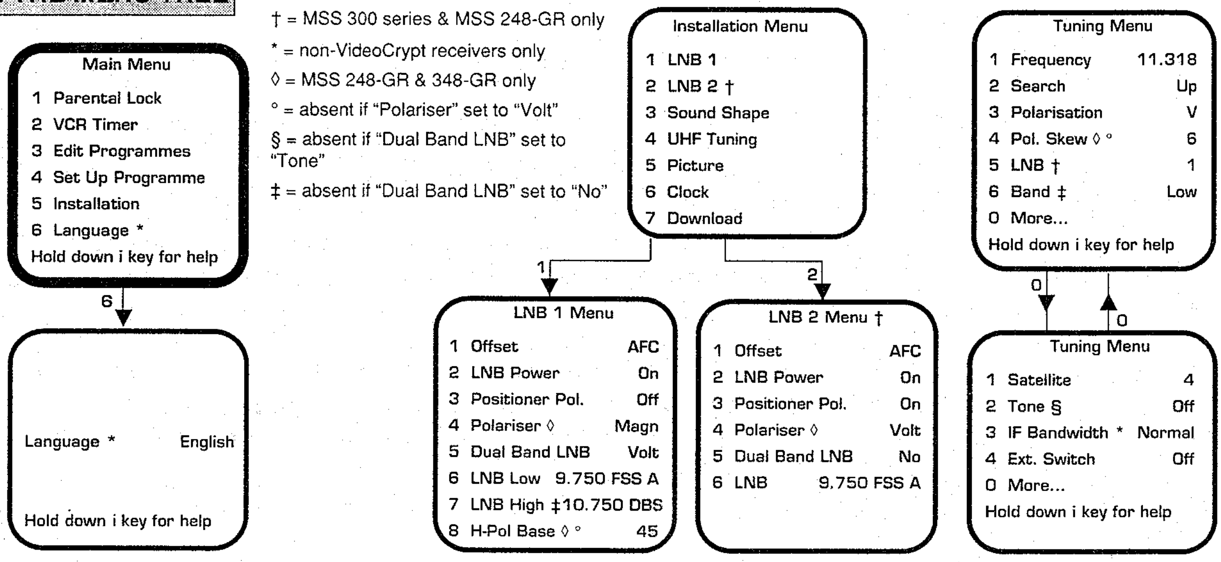
CONNECTORS

LNB	Single F-type (MSS 200-I & MSS 232-G); dual F-type (MSS 300 series & MSS 248-GR)
AV Phono Sockets	Present on MSS 248-GR and MSS 348-GR only
Polariser Connector	Present on MSS 248-GR and MSS 348-GR only

TUNER

Receiving Freq. Range	700 - 2150 MHz (all models exept MSS 200-I) 920 - 2050 MHz (MSS 200-I) (soon to be upgraded to the above)
I.F. Bandwidth	27 MHz (MSS 200-I and MSS 301-I) 18/27 MHz (MSS 232-G and MSS 334-G) 15/27 MHz (MSS 248-GR and MSS 348-GR)

IN THE MENU TREE



† = MSS 300 series & MSS 248-GR only
* = non-VideoCrypt receivers only
◊ = MSS 248-GR & 348-GR only
° = absent if "Polariser" set to "Volt"
§ = absent if "Dual Band LNB" set to "Tone"
‡ = absent if "Dual Band LNB" set to "No"

Main Menu
1 Parental Lock
2 VCR Timer
3 Edit Programmes
4 Set Up Programme
5 Installation
6 Language *
Hold down i key for help

Language * English
Hold down i key for help

Installation Menu
1 LNB 1
2 LNB 2 †
3 Sound Shape
4 UHF Tuning
5 Picture
6 Clock
7 Download

LNB 1 Menu
1 Offset AFC
2 LNB Power On
3 Positioner Pol. Off
4 Polariser ◊ Magn
5 Dual Band LNB Volt
6 LNB Low 9.750 FSS A
7 LNB High ‡10.750 DBS
8 H-Pol Base ◊ ° 45

LNB 2 Menu †
1 Offset AFC
2 LNB Power On
3 Positioner Pol. On
4 Polariser ◊ Volt
5 Dual Band LNB No
6 LNB 9.750 FSS A

Tuning Menu
1 Frequency 11.318
2 Search Up
3 Polarisation V
4 Pol. Skew ◊ ° 6
5 LNB † 1
6 Band ‡ Low
0 More...
Hold down i key for help

Tuning Menu
1 Satellite 4
2 Tone § Off
3 IF Bandwidth * Normal
4 Ext. Switch Off
0 More...
Hold down i key for help

IN SETTING UP THE RECEIVER FOR THE ATTACHED LNB(S)

For the MSS 300 series and the MSS 248-GR, there are two LNB inputs, and the receiver is preset for both LNB 1 and LNB 2 to be 9.750 FSS A. You need to press MENU, 5, 2 to reach the LNB 2 Menu.

Changing the Offset

To change the offset for LNB 2, save the offset for LNB 1 and return to normal viewing mode. Select a programme being received at LNB 2, then display the LNB 2 Menu to change the "Offset" option.

Turning the LNB Power On/Off

If "On" is set at both LNB Menus, power goes only to the LNB which is receiving the current programme.

Changing the LNB Setting

An additional band is available for non-VideoCrypt receivers:

LNB Band	Freq. Range (GHz)	Typical Satellites
5.150 CBand	3.700 – 4.200	Arabsat

Note that you cannot use the number keys to key in C-Band frequencies at the Tuning Menu; you must use ◄ and ►. CBand becomes an additional available band for both LNB High and LNB Low.

IN THE OSCILLOGRAMS

The main board oscillograms are the same for VideoCrypt and non-VideoCrypt receivers, except that the following text is added for non-VideoCrypt receivers:

At Test Point 10: LK178

If the trace is not as shown, check:

- Q80, Q81, Q82, Q83 and associated components in the sync. separator circuitry
- Check that the trace is also at pin 39 of U4; if it is not, check the path including the mod. wire between hole 5 of U8 and LK84.

At Test Point 11: LK177

If the trace is not as shown, check:

- Q80, Q81, Q82, Q83 and associated components in the sync. separator circuitry.

OTHER DIFFERENCES

As the MSS 300 series receivers have a vacuum fluorescent display (VFD), the displayed channel number during UHF tuning is of the form CH38FT0 where 38 is the default channel number and FT is the fine tune value. During PIN reset the message RESET PIN appears on the front panel display.

U1, the processor on the display board, decodes the IR1 data and communicates with U4 on the main board. The power supply provides –21 V at pin 6 of T2 and this passes to the display board, where it is needed for the VFD.

To reach the Download Menu in MSS 300 series and MSS 248-GR receivers, press MENU, 5, 7.

MECHANICAL PARTS LIST DIFFERENCES BETWEEN THE MODELS (at 11.11.94)

Below are details of the differences in mechanical parts for the various models in the MSS 200 and MSS 300 series. In each case they are compared with the MSS 200-I, whose mechanical parts are listed in the main manual (with updates on page 12 of this addendum).

The following mechanical parts are required on all models which have a U4 extension PCB rather than a masked U4:

FIT TO U4:

2 OFF	SOCKET 20 WAY TOP ENTRY (HARWIN)	161-2002001

OTP SUPPORT:

1 OFF	PILLAR - LCBS- 14 (RICHCO)	248-0014002

The following MSS 301-I mechanical parts are different from the MSS 200-I:

1 OFF	*A*MANUAL MSS301-I D/LNB PAL-I PACE	502-3010100
1 OFF	*A*START-UP GUIDE - MSS301-I MANUAL	505-3010100
1 OFF	CABLE-10WAY 125MM MSS300 DISPLAY FFC	198-0125100
1 OFF	CARTON-MSS300 BRANDED PACE (POLY SIZE)	412-0300101
1 OFF	COVER-MSS300 SERIES	312-3000000
1 OFF	FRONT PANEL- MSS301-I D/LNB IRD PACE	360-3011100
2 OFF	MSS 300 END CAP	442-0300100

Note that the end cap is fitted instead of the polystyrene.

1 OFF	VFD PIN SUPPORT STRIP	249-3000100

The numbers of the following components have increased to:

2 OFF	HALF NUT-3/8 FORM TOI.2A	240-1380011
4 OFF	PLASTITE SCREW-4 X 1/4 POZI PAN BLACK	245-4140011

The blanking grommet (part no: 306-7890000) is not fitted on MSS 301-I.

The following MSS 232-G mechanical parts are different from the MSS 200-I:

1 OFF	*A* MAINS CABLE-EURO "8" + 2 PIN PLUG	191-2015280
1 OFF	*A*MANUAL MSS232-G S/LNB PAL-G PACE	502-2000100
1 OFF	*A*START-UP GUIDE - MSS232-G MANUAL	505-2020100
1 OFF	CABLE-COAX UHF M-TO-F 1.5M BLACK "FTZ"	198-0015121
1 OFF	MSS232-G FRONT PANEL	360-2000100
1 OFF	PROG LIST SHEET - MSS1034-G NON-IRD PACE	504-1001100

The following MSS 334-G mechanical parts are different from the MSS 200-I:

1 OFF	*A* MAINS CABLE-EURO "8" + 2 PIN PLUG	191-2015280
1 OFF	*A*MAN MSS2/300 SER PAL-G D/LNB (ENG/GER)	502-2100100
1 OFF	*A*START/GUIDE - MSS2/300 SER PAL-G D/LNB	505-2230100
1 OFF	CABLE-COAX UHF M-TO-F 1.5M BLACK "FTZ"	198-0015121
1 OFF	CABLE-10WAY 125MM MSS300 DISPLAY FFC	198-0125100
1 OFF	CARTON-MSS300 BRANDED PACE (POLY SIZE)	412-0300101
1 OFF	COVER-MSS300 SERIES	312-3000000
1 OFF	MSS334-G FRONT PANEL	360-3000100
2 OFF	MSS 300 END CAP	442-0300100

Note that the end cap is fitted instead of the polystyrene.

1 OFF	PROG LIST SHEET - MSS1034-G NON-IRD PACE	504-1001100
1 OFF	VFD PIN SUPPORT STRIP	249-3000100

The numbers of the following components have increased to:

2 OFF	HALF NUT-3/8 FORM TOI.2A	240-1380011
4 OFF	PLASTITE SCREW-4 X 1/4 POZI PAN BLACK	245-4140011

The blanking grommet (part no: 306-7890000) is not fitted on MSS 334-G.

The mechanical parts for the MSS 248-GR and MSS 348-GR are the same as for the MSS 232-G and MSS 334-G respectively, except that the base and manuals are different (as given below) and there are some additional components:

1 OFF	*A*MAN MSS2/300 SER PAL-G D/LNB (ENG/GER)	502-2100100
1 OFF	*A*START/GUIDE - MSS2/300 SER PAL-G D/LNB	505-2230100
1 OFF	MSS248/348 METAL BASE IRTE/2PHONO	321-3001100
1 OFF	CABLE - 5 WAY 165MM RIBBON FFC	198-0165050
3 OFF	PLASTITE SCREW-4 X 1/4 POZI PAN BLACK	245-4140011

The blanking grommet (part no: 306-7890000) is not fitted on MSS 248-GR.

ELECTRICAL PARTS LIST DIFFERENCES BETWEEN THE MODELS (at 11.11.94)

This page gives electrical parts list differences (for the main board) between the various models in the MSS 200 and MSS 300 series. See page 6 for the display board parts list and page 11 for the polariser electrical parts.

Models currently have different tuners as follows:

MSS200	PACE PC77G01 2GHZ S/LNB FIXED 'F'TUN	221-2077012
MSS232	PACE PC78G04 2.15GHZ S/LNB (18/27)'F'TUN	221-2078042
MSS248	PACE PG78G03 2.15GHZ D/LNB (15/27) 'F' TUN	221-2178032
MSS301	PACE PG78G01 2.15GHZ D/LNB FIXED 'F' TUN	221-2178012
MSS334	PACE PG78G04 2.15GHZ D/LNB (18/27) 'F' TUN	221-2178042
MSS348	PACE PG78G03 2.15GHZ D/LNB (15/27) 'F' TUN	221-2178032

Each model has a different U4 on an extension PCB as follows (MSS 200-I now has masked U4 - see page 12):

MSS232	EPROM-27256 MSS232 4-LANG (805-0200101)	805-0200101
MSS301	EPROM-27256 MSS300 ENG (805-0300100)	805-0300100
MSS334	EPROM-27256 MSS334 4-LANG (805-0300101)	805-0300101

For models without a masked U4, R593 is different as follows:

R593	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501

Note that the MSS 248-GR and MSS 348-GR should have the masked U4 right from the start of manufacture as follows:

MSS248	8663 PROC MSS200 ALL SERIES (809-8663207)	809-8663207
MSS348	8663 PROC MSS300 UNIVERSAL (809-8663301)	809-8663301

The following components which are fitted on the MSS 200-I and MSS 301-I main board are not fitted on the non-VideoCrypt receivers:

C91-99, C102-119, C121-124, C128, C129, C131, C132, C135, C136, C219, C249, C259, C260, C284, C308, C313-316, CARD1, D20-28, D42, D48-51, D59, D60, J5, J10, J11, L13-15, L18, L19, L27, L42 *, L43, HAND MODIFICATION - ECO S000772A (see page 6 of this sheet) LK59, LK60, LK62-64, LK66, LK69, LK79, LK84, LK86, LK90, LK91, LK95-99, LK105-107, LK109, LK112-120, LK122-127, LK134, LK172, LK173, LK183, LK222, Q9, Q10, Q15-18, Q20, Q46, Q65, Q72, R78-81, R106-151, R154-156, R159-161, R164-180, R279, R291-293, R368, R414, R439, R467, R481, R482, R488, R491, R522, R555, R560, R563, R564, R588, R592, R601, R602, TST1, U8-13, U15, U18, X2, X3

* L42 is fitted on MSS 248-GR and 348-GR but not on 232-G or 334-G

The following MSS 300 series/MSS 248-GR parts are different from MSS 200-I/232-G parts or are not fitted on the main board of MSS 200-I/232-G receivers:

C101	1000UF 35V DJ3 RADIAL ELECT CAP 5MM TR	855-1083951
C138*	47UF 16V 5MM RADIAL ELECT' CAP TR	155-4761751
C139*	47UF 16V 5MM RADIAL ELECT' CAP TR	155-4761751
C146	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
D30*	SIGNAL DIODE-1N4148 75MA 75V TR	120-0414801
D47	DIODE-BYV95A (PHILIPS) TR	120-0009511
PL1	FE CONNECTOR-10 WAY TOP ENTRY FE-10-BT	161-2001010
Q21*	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q22*	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q24*	TRANSISTOR - BD329 NPN TO-126 PACKAGE	110-0032901
Q28*	SMD TRANS-BC846B/2SC2412KT146R SOT-23	911-1084651
R158	2K7 0.25W 5% CARBON FILM RES TR	140-2722501
R181*	SMD 22R 0.1W 5% RES 0805 (TRS)	940-2200501
R182*	SMD 22R 0.1W 5% RES 0805 (TRS)	940-2200501
R183*	SMD 22K 0.1W 5% RES 0805 (TRS)	940-2230501
R185*	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R186*	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R187*	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R196*	1K2 0.25W 5% CARBON FILM RES TR	140-1222501
R200*	SMD 6K8 0.1W 5% RES 0805 (TRS)	940-6820501
R203*	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R204*	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R206*	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R441*	1K5 0.25W 1% METAL FILM RES TR	141-1522101
R546	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501

* = fitted on the MSS 248-GR as it is a dual-input model.

The following components which are fitted on the MSS 200 series receivers are not fitted on the main board of the MSS 300 series receivers:

IR1, J7*, L12, LED1, Q11-14, R88-94, R98-100, R104, R494, SW1B, SW2, SW3, SW4B, U6

* = not fitted on the MSS 248-GR as it is a dual-input model.

The following parts for non-VideoCrypt models are different from the MSS 200-I/301-I parts or are not fitted in the MSS 200-I/301-I receivers:

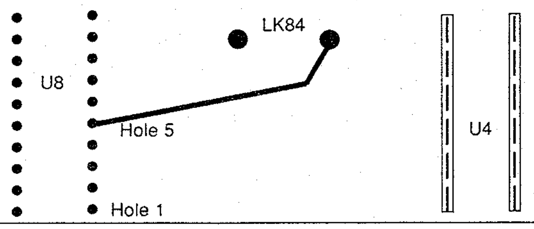
C29	SMD 180PF 50V 5% CER COG CAP 0805 TR	950-1815501
C126	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501
C226	SMD 270PF 50V 5% CER.CAP 0805 (TRS)	950-2715501
C227	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C228	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C229	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C237	47UF 16V 5MM RADIAL ELECT' CAP TR	155-4761751
C239	47UF 16V 5MM RADIAL ELECT' CAP TR	155-4761751
J4	TINNED COPPER WIRE LINKS 0.61MM DIA-PMF	999P1099901
L41	TINNED COPPER WIRE LINKS 0.61MM DIA-PMF	999P1099901
Q54	SMD TRANS-BC846B/2SC2412KT146R SOT-23	911-1084651
Q64	SMD TRANS-BC846B/2SC2412KT146R SOT-23	911-1084651
Q80	SMD TRANS-BC846B/2SC2412KT146R SOT-23	911-1084651
Q81	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q82	SMD TRANS-BC846B/2SC2412KT146R SOT-23	911-1084651
Q83	SMD TRANSISTOR-FMMT2369A SOT-23	911-0236951
R56	SMD 6K2 0.1W 1% RES 0805 (TRS)	940-6220101
R87	SMD 2K2 0.1W 1% RES 0805 (TRS)	940-2220101
R277	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R322	SMD 0.1W 5% ZEROHM LINK 0805 (TRS)	940-0000501
R323	SMD 680R 0.1W 5% RES 0805 (TRS)	940-6810501
R324	SMD 3K9 0.1W 5% RES 0805 (TRS)	940-3920501
R325	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R365	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R366	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R367	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R369	SMD 0.1W 5% ZEROHM LINK 0805 (TRS)	940-0000501
R428	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R429	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R430	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R431	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R432	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R433	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R434	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R435	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R436	SMD 22K 0.1W 5% RES 0805 (TRS)	940-2230501
R437	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
U19	SMD IC-74HC4053 (TR)	902-1405301

Hand modification to route the horizontal sync. pulses to the the microprocessor U4 (ECO S000743).

For this ECO the wire link LK84 was removed, and the following mod. wire added between hole 5 of U8 and LK84 as shown in the diagram below.

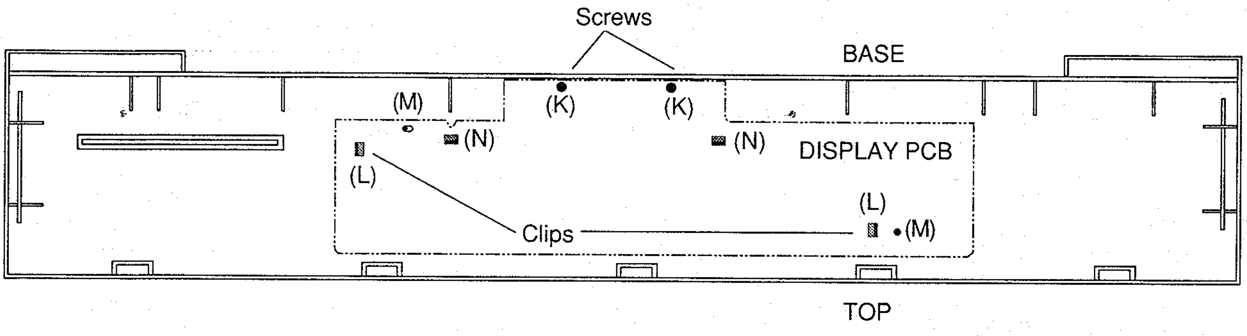
MOD WIRE-0.5 X 60MM BLACK	190-0506001

In addition in ECO S000743, the value of R87 changed and then it changed again in ECO S000796 to the value given in the list shown above.



REMOVING THE DISPLAY BOARD FROM THE FRONT PANEL

Before attemping to remove the display board from inside the front panel, unplug the ribbon cable which connects the display board to PL1 on the main PCB.


Screws
BASE
(M)
(K)
(K)
(N)
(N)
DISPLAY PCB
(L)
Clips
(L)
(M)
TOP

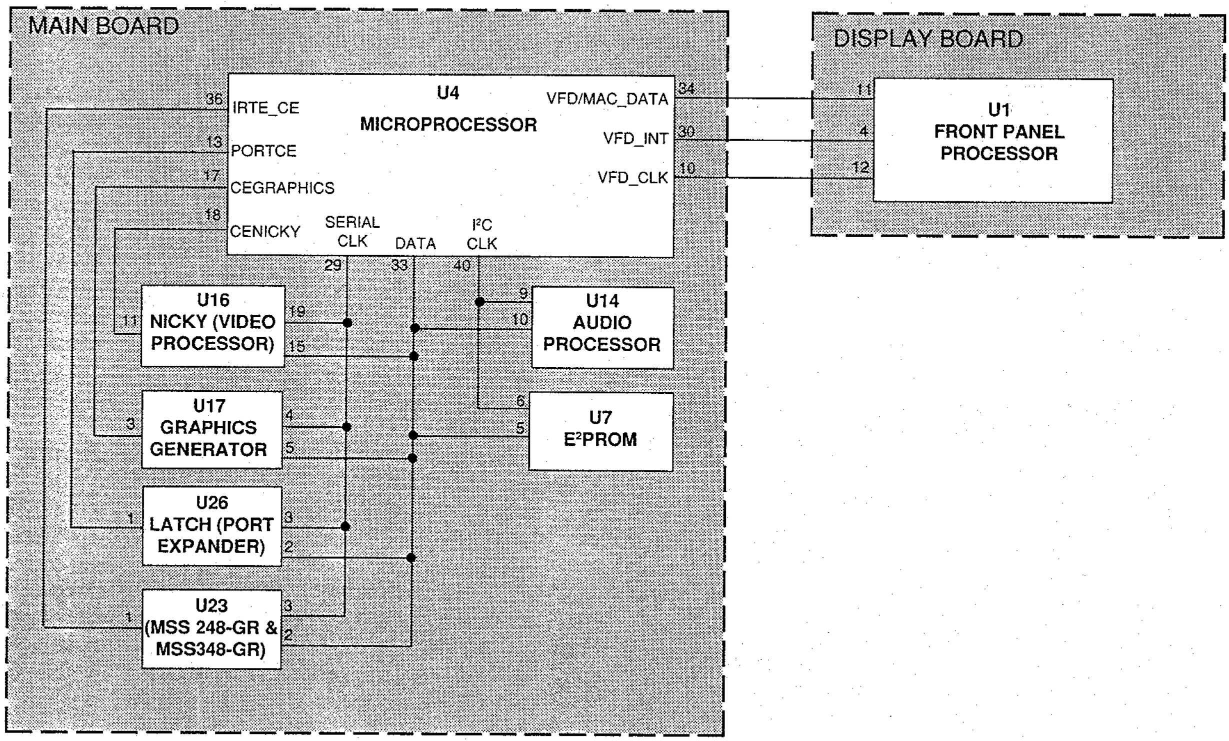
Remove the 2 screws (K).

Gently pull back the 2 clips (L) to release the PCB and lift it from the front panel.

To re-insert the PCB, locate the holes (M) over the location posts inside the front panel moulding and push it down over the clips (L). Refasten the screws (K) (torque: 35 to 40 Ncm).

Note on removing the VFD from the display PCB: Pull back the 2 clips (N) (the pins of the VFD are still soldered to the PCB).

BLOCK DIAGRAM OF CLOCK AND DATA CONTROL LINES


MAIN BOARD
U4
MICROPROCESSOR
36 IRTE_CE
13 PORTCE
17 CEGRAPHICS
18 CENICKY
SERIAL CLK 29
DATA 33
I²C CLK 40
VFD/MAC_DATA 34
VFD_INT 30
VFD_CLK 10
U16
NICKY (VIDEO PROCESSOR)
11
19
15
U17
GRAPHICS GENERATOR
3
4
5
U26
LATCH (PORT EXPANDER)
1
3
2
U23
(MSS 248-GR & MSS348-GR)
1
3
2
U14
AUDIO PROCESSOR
9
10
U7
E²PROM
6
5
DISPLAY BOARD
U1
FRONT PANEL PROCESSOR
11
4
12

GRID REFS AND ELECTRICAL PARTS LIST FOR DISPLAY BOARD

GRID REFS - DISPLAY CIRCUIT DIAGRAM

* = not fitted

CAPACITORS

C1	D6
C2	D3
C3*	B3
C4*	B3
C5	B3
C6	B3
C7	B2
C8	D3
C10	C1
C11	C1
C12	B2
C15	B3
C16	B3
C17	B3
C18	D6
C19	B3
C20	B1
C21	B1
C22	C2
C23	D3
C24	D3
C25	D3

DIODES

D1	D2
D2	D2

INDUCTORS

L1	B2

LINKS

J1	B3

CONNECTORS

PL1	B1

TRANSISTORS

Q1	C5
Q2	B5
Q3	B5
Q4	A5
Q5	D3
Q6	D3
Q7	A5
Q8	D2
Q9	D3

RESISTORS

R1	D6
R2	D6
R3*	C5
R4	C5
R5*	B5
R6	B5
R7*	B5
R8	B5
R9*	B5
R10	A5
R13*	A5
R14	A5
R16	B3
R17	C6
R18	B6
R19	B6
R20	B6
R21	A6
R22	D3
R24	A3
R25	A3
R26	D2
R27	D2
R28	D2
R29	D3
R30	D3
R31	D3
R32	B1

ICS

U1	B4

MISC. COMPONENTS

IR1	B2
SW1	A3
SW2	A3
SW3	A3
SW4	A3
VFD1	D6
X1	B3

GRID REFS - DISPLAY PCB IDENT DIAGRAMS

* = not fitted
† = on SMD side of PCB

CAPACITORS

C1	C9
C2	C2
C3	B6†
C4	B6†
C5	B7
C6	B5†
C7	C7†
C8	C2†
C10	B9†
C11	B9
C12	C8
C15	C5†
C16	C5†
C17	C5†
C18	C8
C19	B5†
C20	B7†
C21	C8†
C22	B9
C23	C3†
C24	C2†
C25	C2

DIODES

D1	C2†
D2	C2†

INDUCTORS

L1	C7

LINKS

J1	C4†

CONNECTORS

PL1	C8

TRANSISTORS

Q1	C6†
Q2	C7†
Q3	C6†
Q4	C6†
Q5	C2
Q6	C2
Q7	C7†
Q8	C2†
Q9	C2†

RESISTORS

R1	B8
R2	B8
R3	B6†
R4	B6†
R5	B7†
R6	B7†
R7	C6†
R8	C6†
R9	C6†
R10	C6†
R13	C7†
R14	C7†
R16	C5†
R17	C6†
R18	C6†
R19	C6†
R20	C6†
R21	C6†
R22	C2†
R24	B6†
R25	B5†
R26	C2†
R27	C2†
R28	C2†
R29	C2†
R30	C3
R31	C3
R32	C8

ICS

U1	C4

MISC. COMPONENTS

IR1	C7
SW1	B5
SW2	B4
SW3	B6
SW4	B4
VFD1	C4
X1	B6

PARTS LIST - DISPLAY BOARD

Capacitors

C1	100UF 25V 2.5MM RADIAL ELECT' CAP	155-1072720
C2	22UF 35V 5MM 20% MINI RAD ELECT' CAP TR	156-2263752
C5	330UF 10V 3.5MM 20% MINI. RAD. ELECT CAP	156-3371730
C6	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C7	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C8	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C10	SMD 100NF 50V 20/80% CER Y5V CAP 0805 TR	950-1045951
C11	10UF 50V 20% 5MM MINI RAD ELECT' CAP TR	156-1065751
C12	10UF 50V 20% 5MM MINI RAD ELECT' CAP TR	156-1065751
C15	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C16	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C17	SMD 1NF 50V 5% CER COG CAP 0805 (TRS)	950-1025501
C18	330UF 25V 3.5MM RADIAL ELECT' CAP	155-3372730
C19	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C20	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C21	SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR	950-2242951
C22	10UF 50V 20% 5MM MINI RAD ELECT' CAP TR	156-1065751
C23	SMD 3.3NF 50V 5% CER X7R CAP 0805 (TRS)	950-3325521
C24	SMD 3.3NF 50V 5% CER X7R CAP 0805 (TRS)	950-3325521
C25	22UF 35V 5MM 20% MINI RAD ELEC' CAP TR	156-2263751

Diodes

D1	SMD DIODE-BAS16/DAN212KT146 SOT-23	912-0001651
D2	SMD DIODE-BAS16/DAN212KT146 SOT-23	912-0001651

Inductors

L1	AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR	130-0180611

Links

J1	SMD 0.1W 5% ZEROHM LINK-0805 (TRS)	940-0000501

Connectors

PL1	FE CONNECTOR - 10 WAY SIDE ENTRY JST	161-2101010

Transistors

Q1	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q2	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q3	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q4	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q5	TRANSISTOR-BC557 PNP TO-92 PACKAGE TR	110-0055701
Q6	TRANSISTOR-ZTX450 (ZETEX) TR	110-0045011
Q7	SMD TRANSISTOR-BC856B SOT-23	911-1085651
Q8	SMD TRANS-BC846B/2SC2412KT146R SOT-23	911-1084651
Q9	SMD TRANS-BC846B/2SC2412KT146R SOT-23	911-1084651

Resistors

R1	22K 0.25W 5% CARBON FILM RES TR	140-2232501
R2	2K2 0.25W 5% CARBON FILM RES TR	140-2222501
R4	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R6	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R8	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R10	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R14	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R16	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R17	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R18	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R19	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R20	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R21	SMD 47K 0.1W 5% RES 0805 (TRS)	940-4730501
R22	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R24	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R25	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R26	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R27	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R28	SMD 15K 0.1W 5% RES 0805 (TRS)	940-1530501
R29	SMD 12K 0.1W 5% RES 0805 (TRS)	940-1230501
R30	220R 0.25W 5% CARBON FILM RES TR	140-2212501
R31	220R 0.25W 5% CARBON FILM RES TR	140-2212501
R32	22R 1W 5% CARBON FILM RES TR	140-2206501

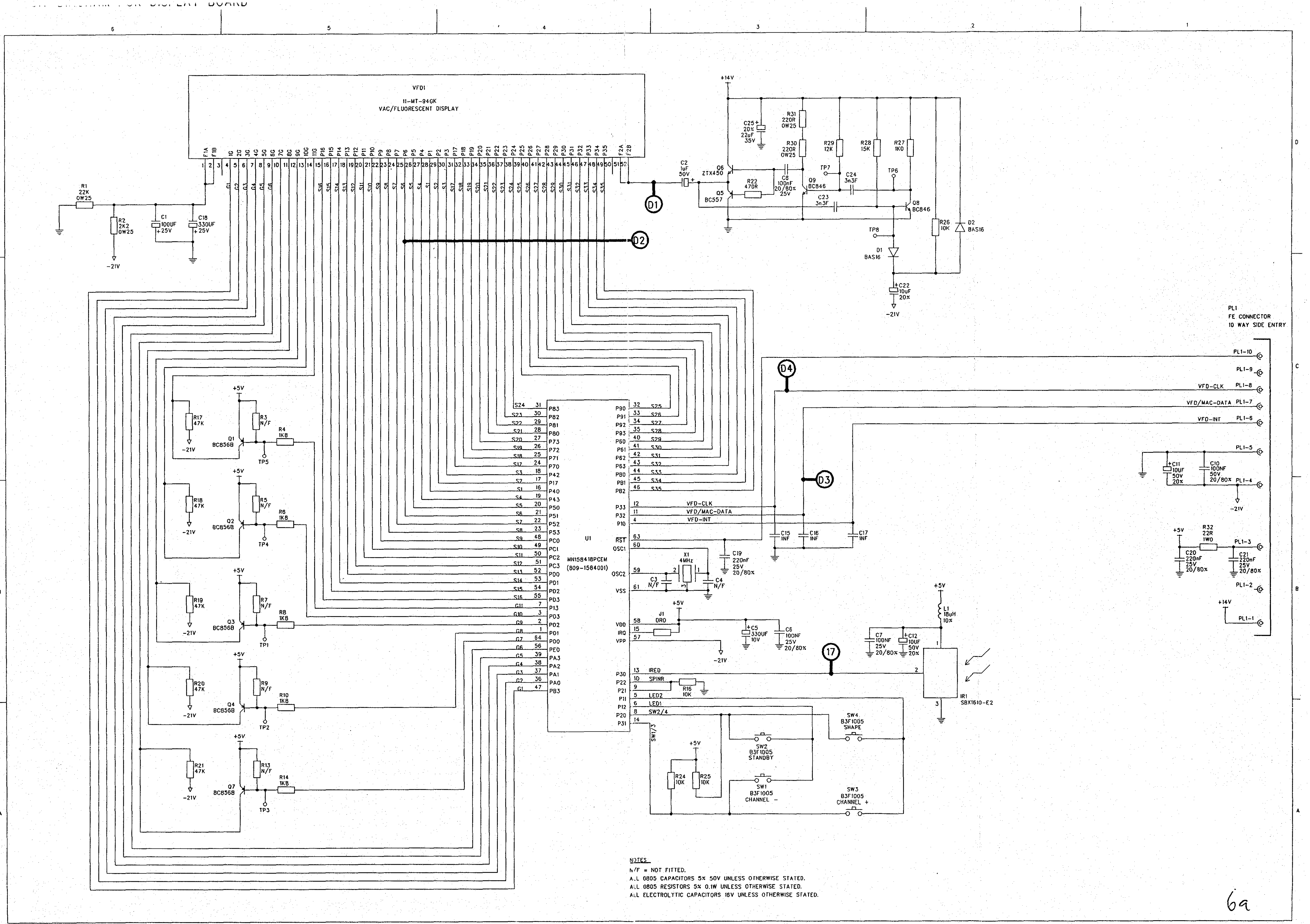
Integrated Circuits

U1	PANASONIC MICRO MN158418PCEM MSS1000	809-1584001

Miscellaneous Components

IR1	SONY INFRA-RED REC MODULE (SBX 1610-E2)	215-1610002
SW1	SWITCH-B3F6005 PCB STANDARD(=B3F1005 TR)	204-0100502
SW2	SWITCH-B3F6005 PCB STANDARD(=B3F1005 TR)	204-0100502
SW3	SWITCH-B3F6005 PCB STANDARD(=B3F1005 TR)	204-0100502
SW4	SWITCH-B3F6005 PCB STANDARD(=B3F1005 TR)	204-0100502
VFD1	VAC/FLUORESCENT DISP 11-MT-94GK	200-0119400
X1	RESONATOR- CST 4.00 MGW-TF01 MURATA	171-0040000

DIAGRAM FOR DISPLAY BOARD


6
5
4
3
2
1
D
C
B
A
VFD1
11-MT-94GK
VAC/FLUORESCENT DISPLAY
U1
MN158418PCEM
(809-1584001)
R1 22K 0W25
R2 2K2 0W25
C1 100UF 25V
C18 330UF 25V
-21V
+14V
C25 20% 22uF 35V
R31 220R 0W25
R30 220R 0W25
R29 12K
R28 15K
R27 1K0
C2 1uF 50V
Q6 ZTX450
Q5 BC557
R22 470R
C8 100nF 20/80% 25V
Q9 BC846
TP7
C24 3n3F
TP6
C23 3n3F
Q8 BC846
TP8
D1 BAS16
R26 10K
D2 BAS16
C22 10uF 20%
D1
D2
D3
D4
17
R17 47K
R3 N/F
Q1 BC856B
R4 1K8
TP5
R18 47K
R5 N/F
Q2 BC856B
R6 1K8
TP4
R19 47K
R7 N/F
Q3 BC856B
R8 1K8
TP1
R20 47K
R9 N/F
Q4 BC856B
R10 1K8
TP2
R21 47K
R13 N/F
Q7 BC856B
R14 1K8
TP3
+5V
VFD-CLK
VFD/MAC-DATA
VFD-INT
C15 1NF
C16 1NF
C17 1NF
C19 220nF 25V 20/80%
X1 4MHz
C3 N/F
C4 N/F
J1 0R0
C5 330UF 10V
C6 100NF 25V 20/80%
IRED
SPINR
R16 10K
LED2
LED1
SW2/4
SW1/3
R24 10K
R25 10K
SW2 B3F1005 STANDBY
SW1 B3F1005 CHANNEL -
SW4 B3F1005 SHAPE
SW3 B3F1005 CHANNEL +
L1 18uH 10%
C7 100NF 25V 20/80%
C12 10UF 50V 20%
IR1 SBX1610-E2
PL1
FE CONNECTOR
10 WAY SIDE ENTRY
PL1-10
PL1-9
PL1-8
PL1-7
PL1-6
PL1-5
PL1-4
PL1-3
PL1-2
PL1-1
C11 10UF 50V 20%
C10 100NF 50V 20/80%
R32 22R 1W0
C20 220nF 25V 20/80%
C21 220nF 25V 20/80%
OSC1
OSC2
VSS
VDD
IRQ
VPP
RST

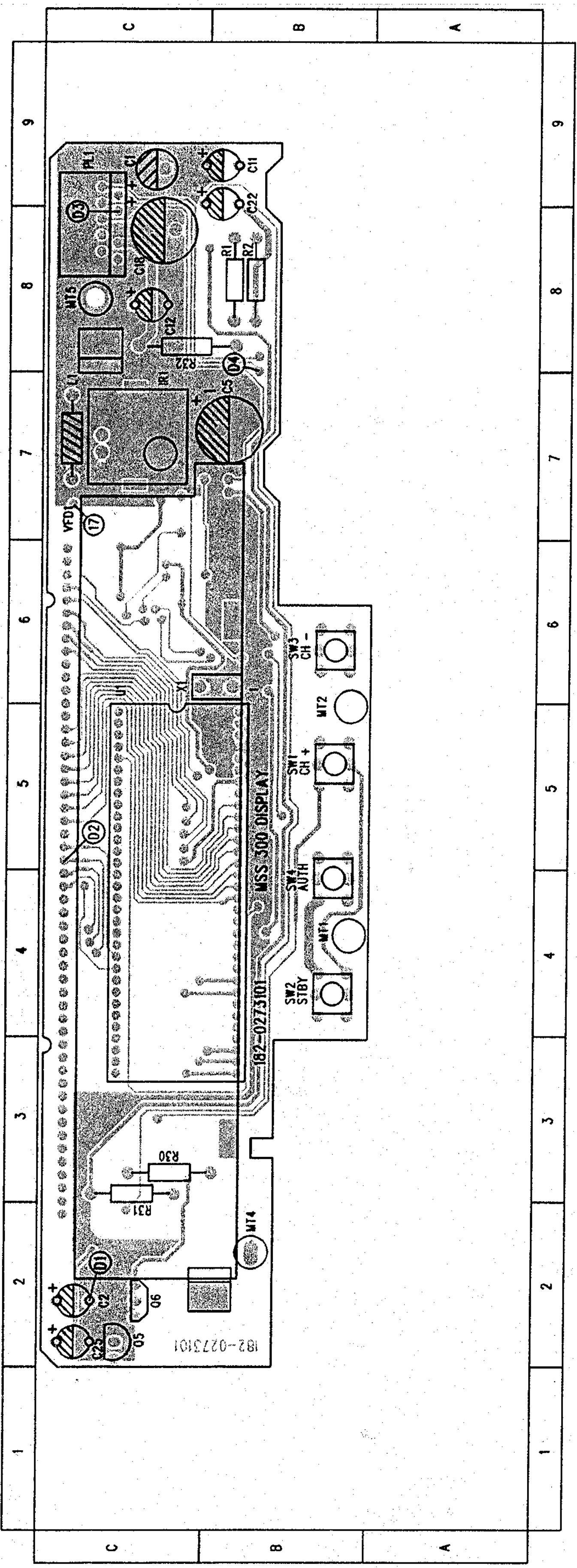
NOTES

N/F = NOT FITTED.
ALL 0805 CAPACITORS 5% 50V UNLESS OTHERWISE STATED.
ALL 0805 RESISTORS 5% 0.1W UNLESS OTHERWISE STATED.
ALL ELECTROLYTIC CAPACITORS 16V UNLESS OTHERWISE STATED.

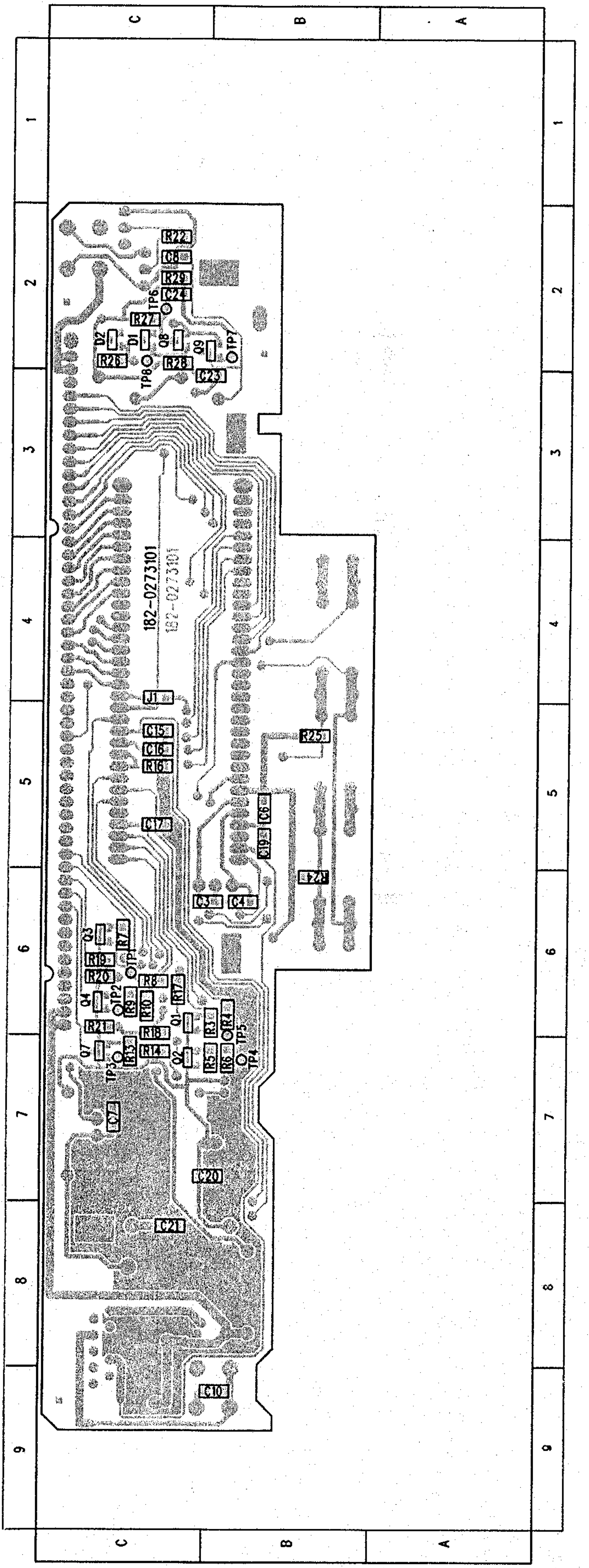
6a

DISPLAY BOARD IDENT DIAGRAMS

COMPONENT SIDE


C
B
A
9
8
7
6
5
4
3
2
1
PL1
C1
C11
C12
Q3
R1
R2
C18
MT5
R32
D12
VFD1
Y1
SW3 CH -
MT2
SW1 CH +
MSS 300 DISPLAY
SW4 AUTH
MT1
SW2 STBY
182-0273101
R30
R31
MT4
Q1
C2
Q6
Q5

SOLDER SIDE


C
B
A
1
2
3
4
5
6
7
8
9
R22
C8
R29
C24
R27
R26
TP6
R28
C23
TP8
TP7
182-0273101
J1
R25
C15
C16
R16
C17
C6
C19
C3
C4
R24
R19
R20
R7
R21
R13
R14
R18
TP2
TP3
TP4
TP5
C7
C20
C21
C10

DISPLAY BOARD CIRCUIT DESCRIPTION

The circuit diagram for the display board is on page 7 of this addendum. The display board comprises an infra-red sensor for the handset commands, the front panel buttons, a vacuum fluorescent display (VFD1) and a microprocessor U1 which controls what appears on the VFD and also the passage of information to the microprocessor U4 on the main PCB.

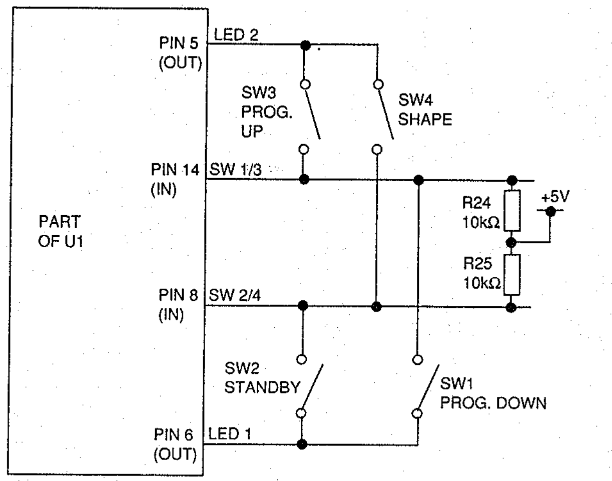
When the receiver powers up, the reset line RST (from the main board) causes pin 63 of U1 to go high. The data, clock and interrupt logic are seen on pins 11, 12 and 4 respectively of U1 and these pass to the main PCB on pins 7, 8 and 6 of PL1 via a ribbon cable to PL1 on the main PCB. When the handset keys are pressed, IR data (see Oscillogram 17) is seen on pin 13 of U1. The microprocessor U1 runs at 4 MHz, determined by crystal X1.

Front Panel Switches

The diagram below shows a simplified version of the switching circuitry. At any instant, output pins 5 and 6 of microprocessor U1 can never both be high, although they will both be low when the receiver is in standby. The input pins 8 and 14 of U1 are normally pulled high by R24 and R25.

U1 checks whether the front panel switches are open or closed as follows. It sets pin 5 low (and therefore pin 6 high) momentarily and checks whether pin 14 is high or low. If it is low, then SW3 (the programme up button) must be closed; if it is high then SW3 must be open. While pin 5 is still low, U1 then checks whether pin 8 is high or low. If it is low then SW4 (the shape button) must be closed; if it is high then SW4 must be open. To check the other two switches, U1 then sets pin 6 low (and therefore pin 5 high) momentarily and checks again whether pin 14 is high or low. If it is low, then SW1 (the programme down button) must be closed; if it is high then SW1 must be open. While pin 6 is still low, U1 then checks whether pin 8 is high or low. If it is low then SW2 (the standby button) must be closed; if it is high then SW2 must be open. If SW2 is detected as being closed, U1 causes the word "Standby" to illuminate on the VFD.

The closing and opening of SW4 causes a stepping through the four preset sound shapes. U1 keeps track of which shape is currently applied and steps to the next in the sequence if a change in SW4 is detected.


PIN 5
(OUT)
LED 2
SW3
PROG.
UP
SW4
SHAPE
PIN 14
(IN)
SW 1/3
PART
OF U1
R24
10kΩ
+5V
R25
10kΩ
PIN 8
(IN)
SW 2/4
SW2
STANDBY
SW1
PROG. DOWN
PIN 6
(OUT)
LED 1

NOTE: Switch Idents on PCB

The PCB idents for the switches do not represent the current funtionality, given below.

Ident	Function
SW1 CH+	Programme down
SW2 STBY	Standby
SW3 CH–	Programme up
SW4 AUTH	Sound shape

Vacuum Fluorescent Display

The supply to the VFD is derived from the +14 V supply at pin 1 of PL1 and the -21 V supply at pin 4 of PL1, this being attached by ribbon cable to PL1 on the main board. Q8 and Q9 form a 22 kHz oscillator, running constantly, whose output is AC coupled via C8 to drive transistors Q5 and Q6, which act as a push-pull pair. This provides an 8 V peak-peak square wave (50% mark to space ratio) which is AC coupled via C2 and drives the filament wires within the VFD (these can be seen as thin horizontal wires across the front of the display). The resistors R1 and R2 hold the filament wires at a DC level of approximately -16 V. R26 and C22 are a reset for the oscillator circuit to ensure it starts on power-up.

The supplied current to the filament wires cause them to heat up and emit electrons. When a segment of the display is turned on (by the application of a positive voltage) the segment attracts the electrons which strike the phosphor coating in the VFD causing it to glow in the applicable segment.

The positive voltage applied to cause illumination is +5 V; the segments are at -21 V when they are extinguished.

The microprocessor U1 controls all of the multiplexing of the lines to the VFD and therefore which segments illuminate at any given instant. Q1, Q2, Q3, Q4 and Q7 are buffer drivers. The illumination of each particular part of the display is controlled by a "grid" line and a "segment" line. The display is divided into 11 grids, grids 1 to 10 being the characters of the 10-character display (starting at the right-hand side) and grid 11 being the rest of the display, as shown in the diagram at the bottom of the page (note that in normal operation, some parts of grid 11 will never illuminate). Each grid is then divided into 35 segments, as shown in the separate diagram of a single character. Each part (generally each word) of grid 11 is a segment.

If you notice a fault in the display, the diagrams allow you to see which grid or segment is affected and therefore which of the tracks on the display PCB should be checked for breaks or shorts. The table (right) cross-references the grid and segment numbers with the pins on the VFD and on U1. There is also a self test sequence for the VFD.

Self Test

To start the test, display the Main Menu then quickly press F, 6, STORE.

The display then illuminates in the following sequence:

- the words "SELF TEST" are displayed;
- the software number is displayed;
- all the grids and segments are illuminated simultaneously;
- each segment is displayed in turn in the form of the word "SEG" followed by a number, alongside which a dot illuminates for each segment in turn (as in the diagram below);
- each grid illuminates in turn;
- the words "ROTARY 00" are displayed, which you should ignore;
- the word "PRESS SW10" is displayed, at which point you should press the ▲ switch (SW1) several times to check it is operating correctly (sequential numbers after the "1" on the display indicate this);
- the preceding step is repeated for each front panel switch in turn (i.e. SW2 is ⏻, SW3 is ▼ and SW4 is SHAPE) and for each you should press the appropriate switch several times to test it.

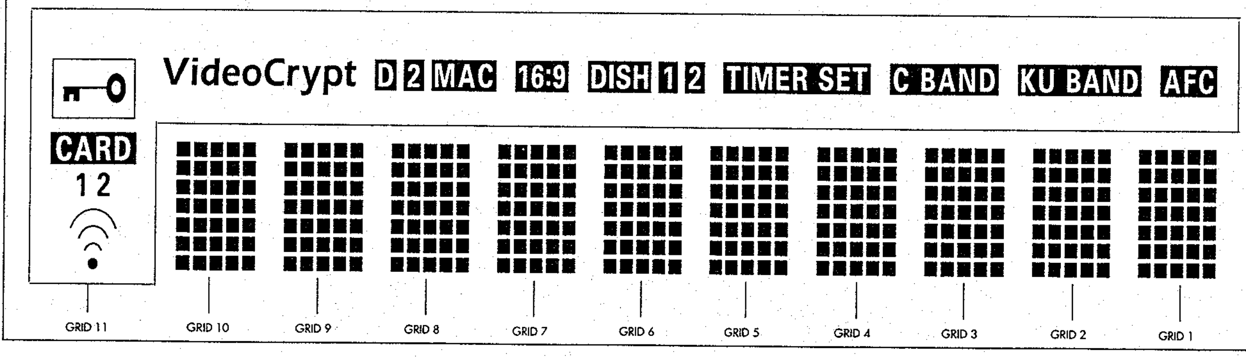
At the end of this test sequence, "TEST END" is displayed and the self test keeps repeating until you press the NORM key to return to normal viewing mode.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

Segment numbers for grids 1 to 10

Grid No.	**VFD Pin**	**U1 Pin**
1	4	47
2	5	36
3	6	37
4	7	38
5	8	39
6	9	56
7	10	64
8	11	1
9	12	2
10	13	3
11	14	7

Seg. No.	**VFD Pin**	**U1 Pin**
1	28	16
2	29	17
3	30	18
4	27	19
5	26	20
6	25	21
7	24	22
8	23	23
9	22	48
10	21	49
11	20	50
12	19	51
13	18	52
14	17	53
15	16	54
16	15	55
17	31	24
18	32	25
19	33	26
20	34	27
21	35	28
22	36	29
23	37	30
24	38	31
25	39	32
26	40	33
27	41	34
28	42	35
29	43	40
30	44	41
31	45	42
32	46	43
33	47	44
34	48	45
35, 36	49	46



OSCILLOGRAMS FOR DISPLAY BOARD FAULT TRACING

NOTE: Oscillogram 17 in the main MSS 200-I Service Manual, which shows the trace at pin 2 of IR1, also applies to the MSS 300 series, except in this case IR1 is located on the display board.

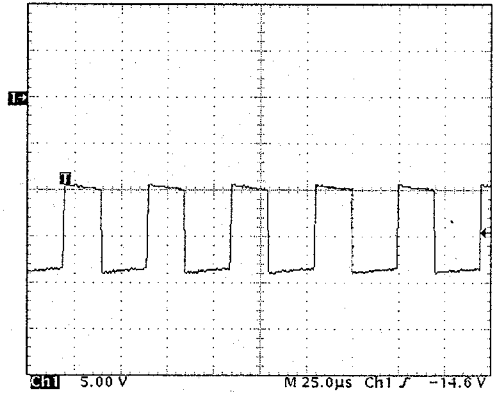
Test Point D1: Pin 52 of display (VFD1) (Display PCB)

Description: The presence of a trace shows that the vacuum fluorescent display can operate.

If the trace is not detected, check:

- Q6, Q5 and associated components on the display PCB;
- Q8, Q9 and associated components on the display PCB which form the oscillator for the 22 kHz signal.

D1. CONTROL DISPLAY PCB



Test Point D2: Pin 25 of VFD1 (Display PCB)

Description: This shows segment 6 of the VFD when SKY NEWS is displayed. The segment numbers diagram on page 9 shows that segment 6 is illuminated for many of the characters.

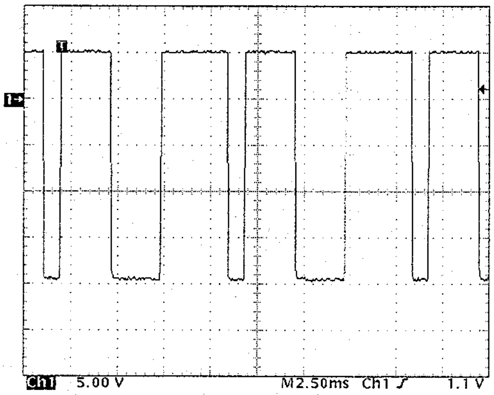
Check that the trace goes from +5 V (illuminated) to −21 V (extinguished). The mark/space ratio depends on the characters displayed. Other segments show a similar trace, but note that for certain combinations of displayed programme names and segments the whole trace may be at -21 V or (unlikely) at +5 V.

The trace for any grid (e.g. pins 4 to 14 of VFD1) should be at +5 V for one eleventh of the time period.

If the trace is not similar to that shown, check:

- VFD1, U1 and associated circuitry;
- Q1, Q2, Q3, Q4, Q7 if you suspect grids 11, 10, 9, 8, 7 respectively.

D2. CONTROL DISPLAY PCB



Test Point D3: Pin 11 of display processor U1 (Display PCB), which is the same as pin 7 of PL1.

Description: The trace shows a typical data signal (VFD/MAC_ DATA) when the handset keys are pressed to change the programme number.

Press the number keys while looking for the trace.

The trace should also look the same at pin 34 of U4 on the main PCB.

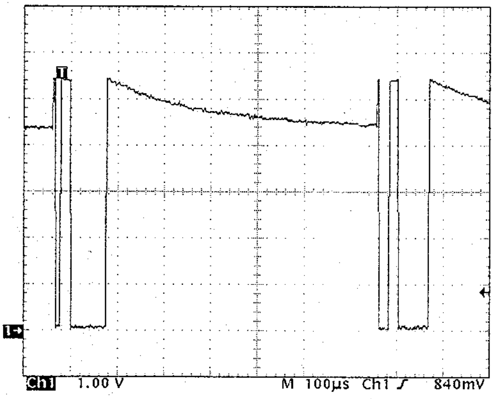
If the trace is not detected, check:

- U1.

If the trace is present at U1 but not at U4, check:

- PL1 on both the main and display PCBs and the ribbon cable between them.

D3. CONTROL DISPLAY PCB



Test Point D4: Pin 12 of display processor U1 (Display PCB), which is the same as pin 8 of PL1.

Description: The trace shows a typical clock signal (VFD_ CLK) when the handset keys are pressed to change the programme number.

Press the number keys while looking for the trace.

The trace should also look the same at pin 10 of U4 on the main PCB.

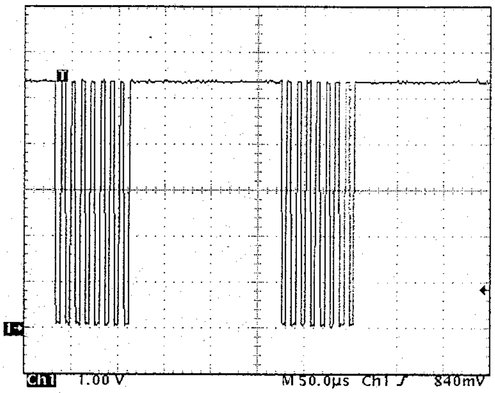
If the trace is not detected, check:

- U1.

If the trace is present at U1 but not at U4, check:

- PL1 on both the main and display PCBs and the ribbon cable between them.

D4. CONTROL DISPLAY PCB



MSS 248-GR AND MSS 348-GR RECEIVERS

These receivers contain circuitry to control an electromagnetic or mechanical polariser, as described in the following section.

They also have two additional phono sockets, one for mono audio and one for video. These are mentioned in the main MSS 200-I Service Manual and are intended for use in countries where SCART connections are not used.

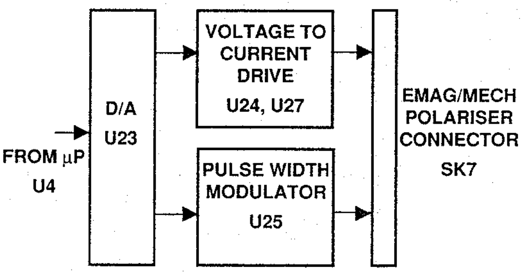
They also contain a 15/27 MHz dual bandwidth tuner (see page 4 of this addendum for part number details).

NOTE: unlike the other receivers in the MSS 200 series, **the MSS 248-GR has two LNB inputs.**

INTEGRAL POLARISER CIRCUITRY

Both the electromagnetic and mechanical polariser are controlled by data from the microprocessor U4 which is passed, for storage, to U23 via strobe, data and clock lines on pins 1, 2 and 3 respectively. U23 and the R-2R resistor ladder network form a D/A converter whose output is buffered by U24B.

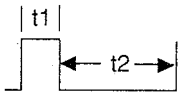
The input to pin 3 of U24B is a static voltage whose level is proportional to the polarisation offset (total of base plus skew) which has been set in the menus. The voltage at pin 5 of U24A is also proportional to the polarisation offset, but is at a much lower level, as it is attenuated by R411 and R412.



Electromagnetic Option

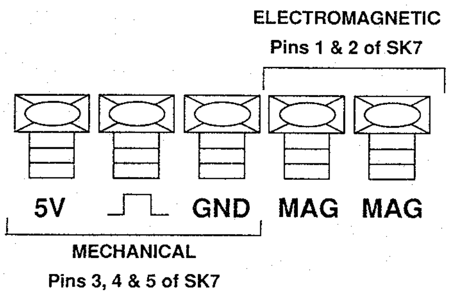
The constant current output to the electromagnetic polariser (i.e. at pins 1 (+ve) and 2 (-ve) of SK7) varies linearly from -90 mA to +90 mA with a 6 bit resolution. Bit 6 sets pin 12 of U23 and controls the direction of the output current via U27, which is a DC motor driver IC. Pin 5 of U27 sets a “forward” direction and pin 6 sets a “reverse” direction.

U24A acts as a difference amplifier. Any current output from U27 flows out at pin 1 and then to ground via R413. This generates a reference voltage on pin 6 of U24A. The voltage from the R-2R ladder is divided down by R411 and R412 to generate a drive voltage on pin 5 of U24A. The voltage difference between pins 5 and 6 is amplified by U24A and the output on pin 7 is used to drive U27 to give the correct output current. This is a feedback network; as the voltage on pin 5 of U24A increases, the voltage on pin 7 increases causing U27 to deliver more current , which in turn forces up the voltage on pin 6 of U24A.



Mechanical Option

Output to the mechanical polariser (i.e. at pins 3, 4 and 5 of SK7) is a pulse width modulated signal derived from U25. The time period, t1, varies linearly between 0.8 and 2.2 ms with 6 bit resolution. The resistor network R410, R424, R578 and R580 sums the output from the D/A converter (i.e. at pin 1 of U24B) with the logic level on pin 12 of U23 and sets the bias on the control pin 5 of U25. At pin 4 of SK7 there are pulses whose width (t1) is proportional to the voltage on pin 5 of U25.



The bias on pin 5 of U25 is compared with the voltage on pin 6 which is derived from the timing components R582 and C273, to define period t1. The combination of timing components R583 and C275 with the bias signal defines a period t2, which is initiated when the output pulse at pin 3 of U25 drops. At the end of t2, the level at pin 7 of U25 also decreases due to the discharge of C273. This allows the start of the next period.

When a programme is selected, the output pulse train is only active for 4 seconds before the microprocessor U4 (via U23) resets U25. In set-up mode the pulse train is maintained while the binary value is changed.

CIRCUIT DESCRIPTION (FOR NON-VIDEOCRYPT RECEIVERS)

The circuit description on pages 14 to 25 inclusive of the main MSS 200-I Service Manual is for a receiver which has an integral VideoCrypt decoder. Most of that description also applies directly to receivers without the decoder, but there is a different sync. separator and control lines CLMP_REF and VC_STATUS are different.

Clamp Reference

As there are no VideoCrypt ICs, there is no CLMP_REF line from the VideoCrypt circuitry to provide the clamp reference at the base of Q45 (and R279, Q46 are not fitted). Instead, R277 is fitted, and this, together with R275 and R276 form a divider from the 5 V line to set the reference voltage at the base of Q45.

Decoder Selector Switch

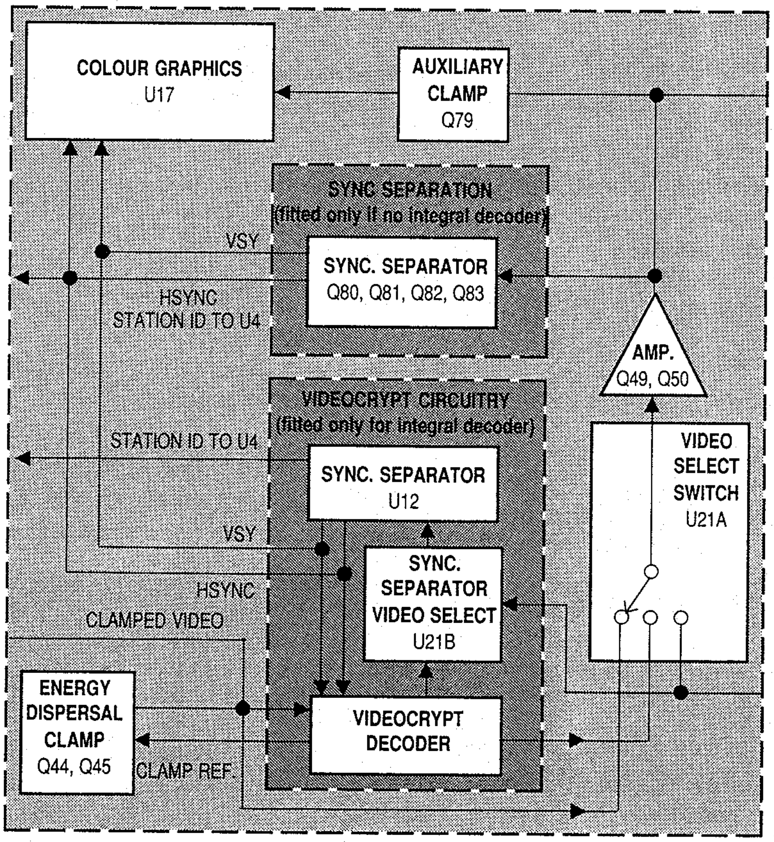
At the decoder selector switch U21A, if pin 9 is low, then "internal" video is switched through and in theory this could be from pin 12 or from pin 14. These pins are under the control of the VC_STATUS line on pin 10, but this is always low because, in the absence of the VideoCrypt ICs, C126 is fitted as a zerohm link. Therefore when pin 9 of U21 is low, pin 12 is always switched to pin 13. U21A therefore passes the "internal" video from the energy dispersal clamp or the "external" video from the external decoder, controlled by the line INT/EXT_VIDEO being low or high respectively. Pins 1 to 5 of U21 (U21B) are not used.

Sync. Separator

The sync. separator for receivers without an integral decoder comprises Q80, Q81, Q82, Q83 and associated components. Q81 is lightly biased on, but, in the presence of a clamped video signal coming in via C227, the positive-going video signal switches off Q81 by reverse biasing its base. When the negative-going sync. pulses arrive however, these switch Q81 hard on so that only the sync. pulses appear at the collector of Q81. The video signal is therefore stripped off to leave the sync. pulses.

The horizontal sync. pulses (HSYNC) are then inverted and buffered by Q83. A low-pass filter comprising R432 and C229 with R434 and R435 extracts the vertical sync. pulses (VSY), which are then inverted and buffered by Q82. Transistor Q80 is a buffer driver for the sync. pulses.

As there is no VideoCrypt IC giving the "station ID" line to indicate a valid video signal, the main microprocessor U4 performs this function by analysing the horizontal sync. pulses which pass via a mod. wire (see the notes on page 4 of this addendum) to enter U4 at pin 39 (line ID_HSYNC). U4 can detect the presence of a 15.625 kHz signal and, if it detects this signal, it follows that there must be a valid signal ("station") which is generating the sync. pulses. The microprocessor U4 has a certain amount of hysteresis in its decision-making so that it can analyse noisy signals. R592 is not fitted for non-VideoCrypt receivers; this informs U4 that it has to analyse the horizontal sync. pulses.



COLOUR GRAPHICS
U17
AUXILIARY
CLAMP
Q79
SYNC SEPARATION
(fitted only if no integral decoder)
VSY
SYNC. SEPARATOR
Q80, Q81, Q82, Q83
HSYNC
STATION ID TO U4
AMP.
Q49, Q50
VIDEOCRYPT CIRCUITRY
(fitted only for integral decoder)
STATION ID TO U4
SYNC. SEPARATOR
U12
VIDEO
SELECT
SWITCH
U21A
VSY
SYNC.
SEPARATOR
VIDEO SELECT
U21B
HSYNC
CLAMPED VIDEO
ENERGY
DISPERSAL
CLAMP
Q44, Q45
CLAMP REF
VIDEOCRYPT
DECODER

ADDITIONAL PARTS LIST FOR MSS 248-GR AND MSS 348-GR RECEIVERS

This is all those parts of the MSS 248-GR and MSS 348-GR which are concerned with the polariser circuitry and the additional AV phono sockets. (* = also fitted on all the other models in the MSS 200 and 300 series.)

Capacitors

C120	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C272	1UF 16V 5MM RADIAL ELECT' CAP TR	155-1051751
C274	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C276	100UF 16V 5MM RADIAL ELECT' CAP TR	155-1071751
C280	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C281	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C286	10UF 16V 5MM RADIAL ELECT' CAP TR	155-1061751
C287	SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR	950-3342951
C288	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C296	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C297	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C298	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951
C311	SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR	950-1042951

Diodes

D57	SIGNAL DIODE IN4148 75MA 75V TR	120-0414801

Inductors

L42	AXIAL INDUCTOR - 18UH 5% 0.5MM	130-0180501

Links

LK186*	TINNED COPPER WIRE LINKS 0.61MM DIA	999-1099902
LK262*	TINNED COPPER WIRE LINKS 0.61MM DIA	999-1099902
LK263*	TINNED COPPER WIRE LINKS 0.61MM DIA	999-1099902
LK264*	TINNED COPPER WIRE LINKS 0.61MM DIA	999-1099902
LK266*	TINNED COPPER WIRE LINKS 0.61MM DIA	999-1099902
LK272*	TINNED COPPER WIRE LINKS 0.61MM DIA	999-1099902
LK302*	TINNED COPPER WIRE LINKS 0.61MM DIA	999-1099902

Connectors

SK6	PHONO SOCKET- DUAL (PEDOKA HSP-202V-16) Y/B	165-2000230
SK7	FE CONNECTOR - 5 WAY TOP ENTRY JST	161-2000510

Transistors

Q19	SMD TRANS-BC846B/2SC2412KT146R SOT-23	911-1084651

Resistors

R162	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R163	SMD 20K 0.1W 5% RES 0805 (TRS)	940-2030501
R221	SMD 20K 0.1W 5% RES 0805 (TRS)	940-2030501
R399	SMD 20K 0.1W 5% RES 0805 (TRS)	940-2030501
R400	SMD 20K 0.1W 5% RES 0805 (TRS)	940-2030501
R401	SMD 20K 0.1W 5% RES 0805 (TRS)	940-2030501
R402	SMD 10K 0.1W 5% RES 0805 (TRS)	940-1030501
R403	SMD 10K 0.1W 5% RES 0805 (TRS)	940-1030501
R404	SMD 10K 0.1W 5% RES 0805 (TRS)	940-1030501
R405	SMD 10K 0.1W 5% RES 0805 (TRS)	940-1030501
R406	SMD 20K 0.1W 5% RES 0805 (TRS)	940-2030501
R407	SMD 20K 0.1W 5% RES 0805 (TRS)	940-2030501
R408	SMD 10K 0.1W 5% RES 0805 (TRS)	940-1030501
R409	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R410	SMD 18K 0.1W 5% RES 0805 (TRS)	940-1830501
R411	SMD 10M 0.1W 5% RES 0805 (TRS)	940-1060501
R412	SMD 1M1 0.1W 5% RES 0805 (TRS)	940-1150501
R413	SMD 3R9 0.1W 5% RES 0805 (TRS)	940-0390501
R423	SMD 100K 0.1W 5% RES 0805 (TRS)	940-1040501
R424	SMD 10K 0.1W 5% RES 0805 (TRS)	940-1030501
R475*	SMD 75R 0.1W 5% RES 0805 (TRS)	940-7500501
R489	SMD 3K3 0.1W 5% RES 0805 (TRS)	940-3320501
R490	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R549*	SMD 0R0 0.1W 5% RES 0805 (TRS)	940-0000501
R577	SMD 0R0 0.1W 5% RES 0805 (TRS)	940-0000501
R578	SMD 5K1 0.1W 5% RES 0805 (TRS)	940-5120501
R579	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R580	SMD 15K 0.1W 5% RES 0805 (TRS)	940-1530501
R581	SMD 4K7 0.1W 5% RES 0805 (TRS)	940-4720501
R582	SMD 5K6 0.1W 5% RES 0805 (TRS)	940-5620501
R583	SMD 120K 0.1W 5% RES 0805 (TRS)	940-1240501
R584	SMD 1K 0.1W 5% RES 0805 (TRS)	940-1020501
R585	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501
R590	SMD 6K8 0.1W 5% RES 0805 (TRS)	940-6820501
R591	SMD 6K8 0.1W 5% RES 0805 (TRS)	940-6820501

Integrated Circuits

U23	CD4094BCN 8 BIT SHIFT AND STORE REGISTER	106-0409400
U24	TLC272CP DUAL CMOS OP AMP LOW BIAS (TI)	100-0027201
U25	555 CMOS SINGLE TIMER (8 DIP PACKAGE)	100-0055501
U27	REVERSIBLE DC MOTOR DRIVER BA6109	107-0610900

Miscellaneous Components

REG1	V/REGULATOR-LM78M05 +5V 0.5A -T0220	105-0780500
REG2	V/REGULATOR-78L12 +12V 100MA TO-92	105-1781200

PCB for Polariser Connector and its components

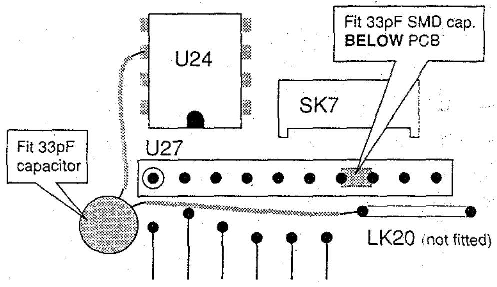
	PCB - IRTE 5 POLE PUSH CONNECTOR ASSY	181-0333101
C1	1000UF 16V 5MM RAD ELEC' CAP (10X16)	155-1081750
C2	1000UF 16V 5MM RAD ELEC' CAP (10X16)	155-1081750
PL1	FE CONNECTOR - 5 WAY TOP ENTRY	161-2000510
R1	2R2 1W 5% CARBON FILM RES TR	140-0226501
SK1	CHAP/IRTE 5 POLE PUSH TERMINAL "CUSTOM"	163-5000501

Retrofitted Components (Diagram 1)

1 OFF	33PF 100V5% CERAMIC CAP	150-3307551
2 OFF	15MM SILICONE SLEEVING	203-1150100
1 OFF	SMD 33PF 50V 5% CER COG CAP 0805	950-3305501

Diagram 1

PCB (Component Side)

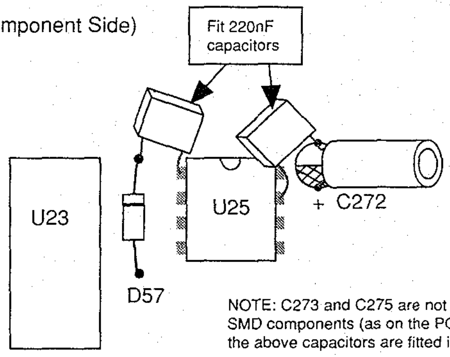


Retrofitted Components (Diagram 2)

2 OFF	220NF 63V 5MM BOX POLYESTER CAP TR	152-2246551

Diagram 2

PCB (Component Side)



NOTE: C273 and C275 are not fitted as SMD components (as on the PCB ident); the above capacitors are fitted instead.

UPDATING MSS 200-I SERVICE MANUAL TO 11.11.94

PARTS LISTS - CHANGES BETWEEN 17.08.94 AND 11.11.94

These changes have occurred to the mechanical parts:

The Addendum Sheet is no longer packed as the User Manual has been re-issued and is now:

1 OFF	*A*MANUAL MSS200-I S/LNB PAL-I PACE ISS2	502-2010101

The packaging has changed and now comprises:

1 OFF	CARTON-MSS200 BRANDED PACE (POLY SIZE)	412-0200100
2 OFF	POLYSTYRENE MSS200 SERIES	442-2300100
1 OFF	BAG-POLYTHENE FOR MKII SAT REC 14X17	400-1141700

One pillar (part no: 248-0014002) has been removed.

There is a new base for MSS 200/300 series receivers (PCO S000348) :

1 OFF	BASE - MSS200/300 UNIVERSAL ISS2	321-3000101

Because of the fitting of the masked microprocessor, these changes have occurred (ECO S000754):

The following components have been added:

U4	8663 PROC MSS200 IRD (809-8663205)	809-8663205
X1	XTAL 16MHZ HC18U 50/50/-10+60 30PF PAR	170-0160000
C86	SMD 47PF 50V 5% CER COG CAP 0805 (TRS)	950-4705501
C87	SMD 47PF 50V 5% CER COG CAP 0805 (TRS)	950-4705501

The 2 off sockets (part no: 161-2002001) and 1 off support (part no: 248-0014002) have been removed as has the U4 extension PCB.

As a result of the fitting of the masked part, R593 has changed as follows (to pull the sense line down harder - ECO S000790):

R593	SMD 2K2 0.1W 5% RES 0805 (TRS)	940-2220501

L40 has been removed and these components have changed to the following values to minimise picture flicker (ECOs S000832 and S000850):

C250	SMD 47PF 50V 5% CER COG CAP 0805 (TRS)	950-4705501
C283	SMD 47PF 50V 5% CER COG CAP 0805 (TRS)	950-4705501
R396	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R529	SMD 220R 0.1W 5% RES 0805 (TRS)	940-2210501

These resistors have been derated; their values have been changed as follows (ECO S000752):

R32	SMD 20R 0.1W 5% RES 0805 (TRS)	940-2000501
R147	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R161	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R212	2K7 0.25W 1% METAL FILM RES TR	141-2722101
R217	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R220	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R282	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R283	SMD 1K8 0.1W 5% RES 0805 (TRS)	940-1820501
R362	SMD 100R 0.1W 5% RES 0805 (TRS)	940-1010501

These resistors have changed their values as follows to reduce the load on gate output (ECO S000772A):

R70	SMD 1K2 0.1W 5% RES 0805 (TRS)	940-1220501
R71	SMD 1K2 0.1W 5% RES 0805 (TRS)	940-1220501

To prevent reduced bandwidth on SVHS Chroma loop-through, R378 has changed as follows (ECO S000772A):

R378	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501

Introduction of a custom resonator for X3, as follows, also results in the removal of L17 from the board (ECO S000562A):

X3	RESONATOR-494.6KHZ TYPE CSB500F47	171-0004940

C245 and C246 have been removed and the components below have changed to minimise frame buzz on UHF audio (ECO S000733):

C39	SMD 10PF 50V 5% CER COG CAP 0805	950-1005501
L38	TINNED COPPER WIRE LINKS 0.61MM DIA-PMF	999P1099901
R73	SMD 150R 0.1W 5% RES 0805 (TRS)	940-1510501
R379	SMD 150R 0.1W 5% RES 0805 (TRS)	940-1510501

These capacitors have changed to 2% tolerance to tighten the specification for PAL/MAC video de-emphasis (ECO S000803):

C222	SMD 390PF 50V 2% CER COG CAP 0805 (TRS)	950-3915201
C223	SMD 390PF 50V 2% CER COG CAP 0805 (TRS)	950-3915201
C225	SMD 100PF 50V 2% CER COG CAP 0805 (TRS)	950-1015201

Q45 has changed as follows to improve clamping and thereby prevent possible frame roll with certain TV types (ECO S000759):

Q45	SMD TRANSISTOR-FMMT2369A SOT-23	911-0236951

These resistors have changed as follows to reduce the factory default volume setting which was too high at the TV SCART (ECO S000785):

R243	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R245	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501
R247	SMD 470R 0.1W 5% RES 0805 (TRS)	940-4710501
R249	SMD 10K 0.1W 5% RES-0805 (TRS)	940-1030501

All wire links have been changed as follows (PCO S000372):

	TINNED COPPER WIRE LINKS 0.61MM DIA	999-1099902

These components have changed to the following values to ease manufacture (PCO S000342):

C58	1000UF 25V DJ3 RADIAL ELECT CAP 5MM	855-1082950
C73	1000UF 25V DJ3 RADIAL ELECT CAP 5MM	855-1082950
C89	1000UF 25V DJ3 RADIAL ELECT CAP 5MM	855-1082950

HAND MODIFICATIONS BETWEEN 17.08.94 AND 11.11.94

The first modification was to remove 3.5 MHz clock lines which were visible on SKY 2 on some sets (ECO S000772A). This involved the removal of C130 and C133 and the retrofitting of the following capacitor between the links LK125 and LK129:

47NF 50V 5MM CERAMIC CAP TR	150-4735951

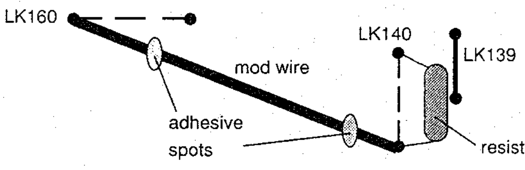
The second modification was to remove audio crackle which can occur at the TV SCART when the receiver is in standby or when there is VCR playback. The modification reduces the 5 V supply to U14 as follows (ECO S000742):

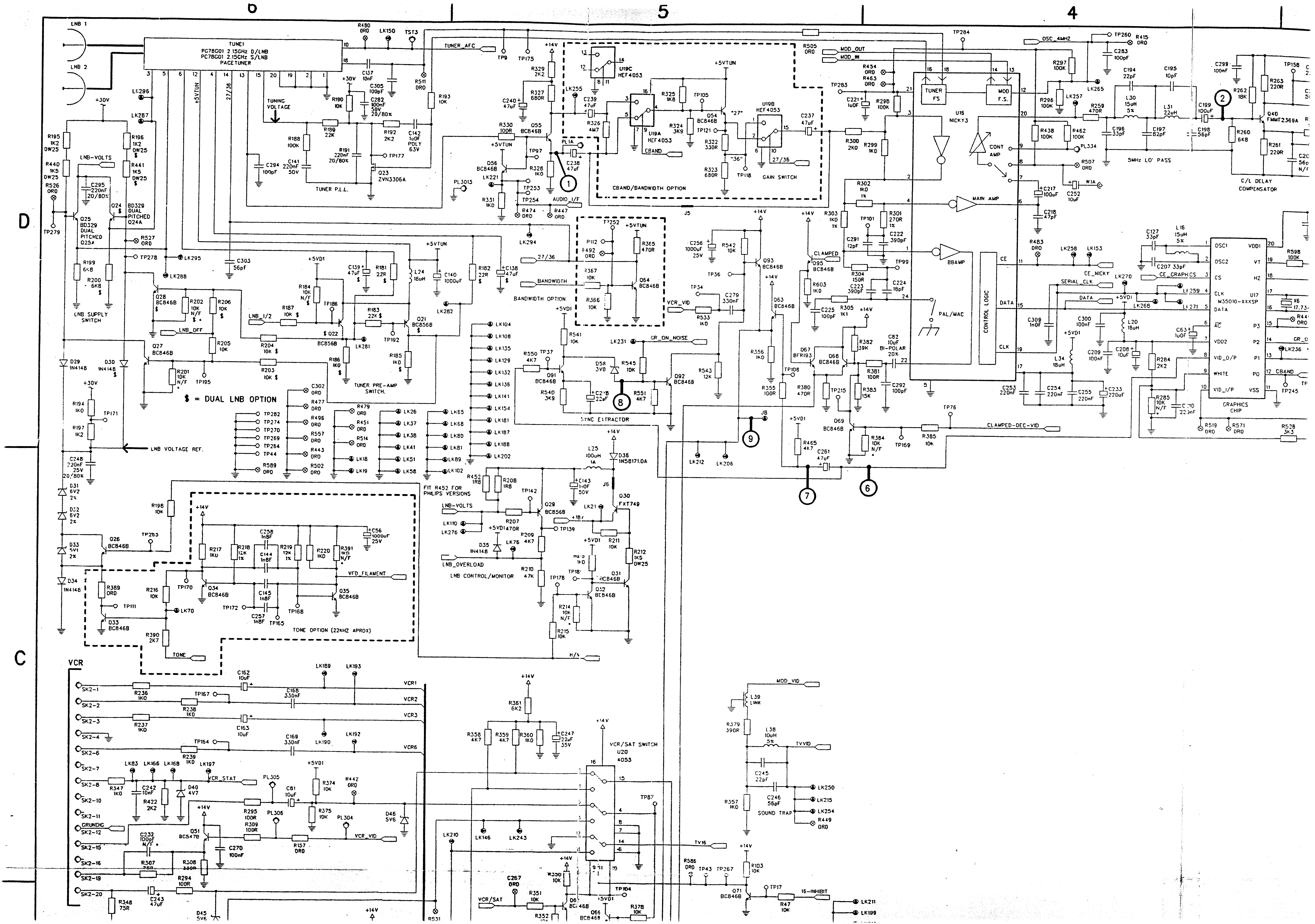
LK160 was removed and LK140 replaced by the following resistor:

LK140	3R3 0.25W 5 5% CARBON FILM RES TR	140-0332501

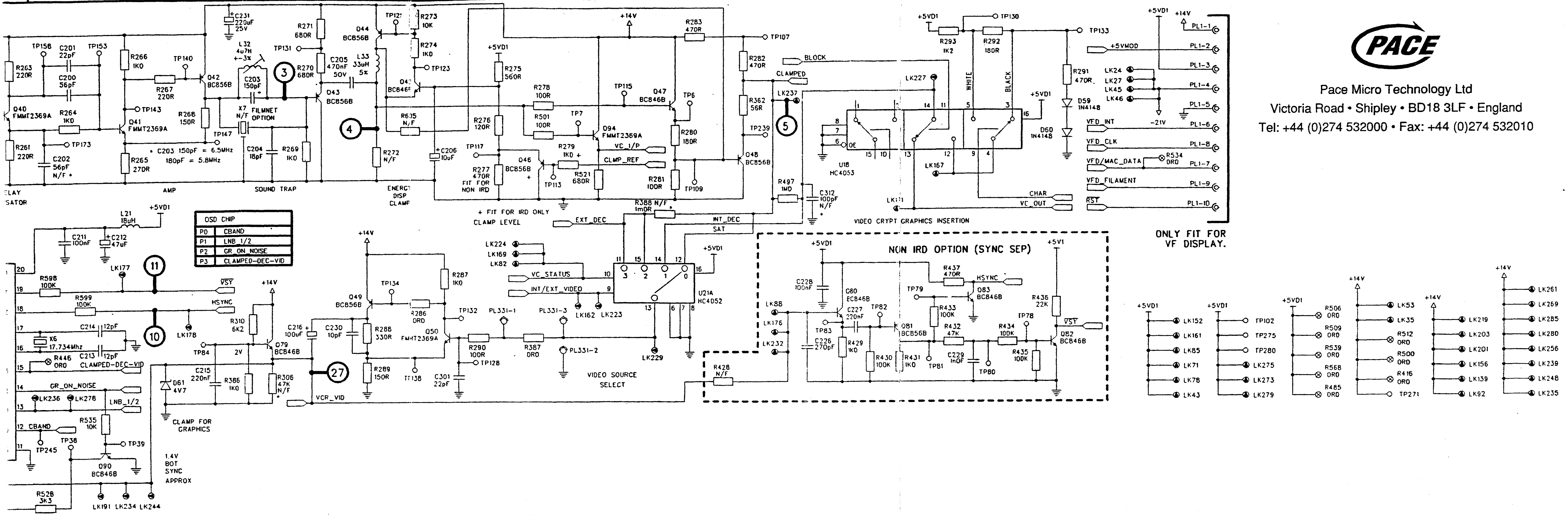
A mod. wire of the following type was fitted between LK160 and LK140 as shown in the diagram and held with hot melt adhesive (ECO S000763A).

MOD WIRE-0.5 X 60MM BLACK	190-0506001
HOT MELT ADHESIVE STICK	206-1059960



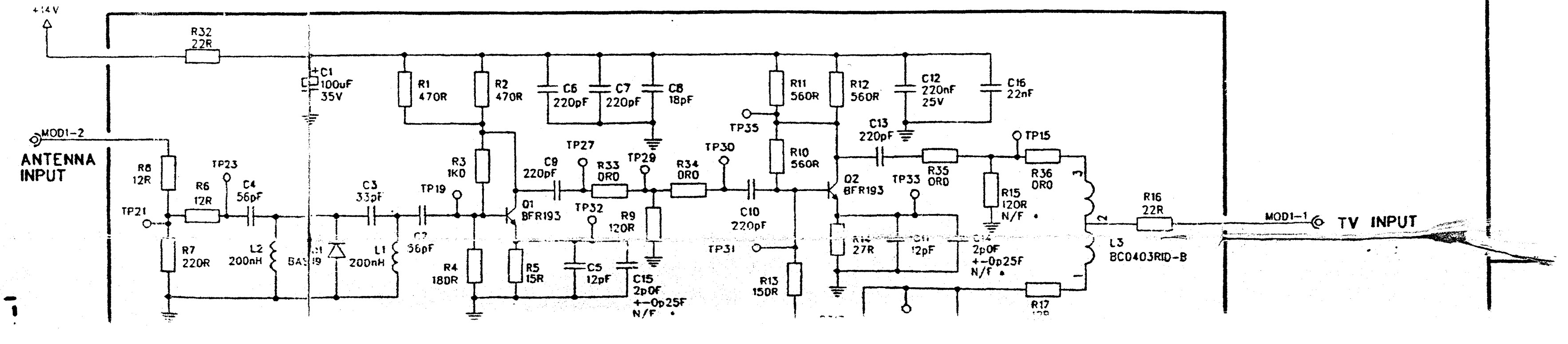
6
5
4
D
C
LNB 1
LNB 2
TUNE1
PG78G01 2.15GHz D/LNB
PG78G01 2.15GHz S/LNB
PACETUNER
TUNER_AFC
TUNING VOLTAGE
TUNER P.L.L.
+30V
LNB-VOLTS
LNB SUPPLY SWITCH
LNB VOLTAGE REF.
$ = DUAL LNB OPTION
TUNER PRE-AMP SWITCH.
LNB_1/2
LNB_OFF
U19C HEF4053
U19A HEF4053
U19B HEF4053
CBAND/BANDWIDTH OPTION
GAIN SWITCH
CBAND
27/36
BANDWIDTH
BANDWIDTH OPTION
AUDIO_I/F
SYNC EXTRACTOR
GR_ON_NOISE
VCR_VID
U16 NICKY3
TUNER F.S.
MOD F.S.
MOD_OUT
MOD_IN
CONT AMP
MAIN AMP
BBAMP
PAL/MAC
CONTROL LOGIC
CLAMPED
CLAMPED-DEC-VID
OSC_4MHZ
5MHz LO' PASS
C/L DELAY COMPENSATOR
Q40 FMMT2369A
U17 M35010-XXXSP
GRAPHICS CHIP
CE_NICKY
CE_GRAPHICS
SERIAL_CLK
DATA
OSC1
OSC2
CS
CLK
AC
VDD2
VID_O/P
WHITE
VID_I/P
VDD1
VT
HZ
P3
P2
P1
P0
VSS
CBAND
FIT R452 FOR PHILIPS VERSIONS
LNB CONTROL/MONITOR
LNB_OVERLOAD
VFD_FILAMENT
TONE OPTION (22KHZ APROX)
TONE
H/V
VCR
VCR1
VCR2
VCR3
VCR6
VCR_STAT
VCR_VID
VCR/SAT SWITCH U20 4053
VCR/SAT
TV16
MOD_VID
TVVID
SOUND TRAP
16-INHIBIT
SK2-1
SK2-2
SK2-3
SK2-4
SK2-6
SK2-7
SK2-8
SK2-10
SK2-11
GRUNDIG
SK2-12
SK2-15
SK2-16
SK2-19
SK2-20
①
②
⑥
⑦
⑧
⑨
J5
J6
J8
+14V
+5VD1
+5VTUN

Pace Micro Technology Ltd
Victoria Road • Shipley • BD18 3LF • England
Tel: +44 (0)274 532000 • Fax: +44 (0)274 532010

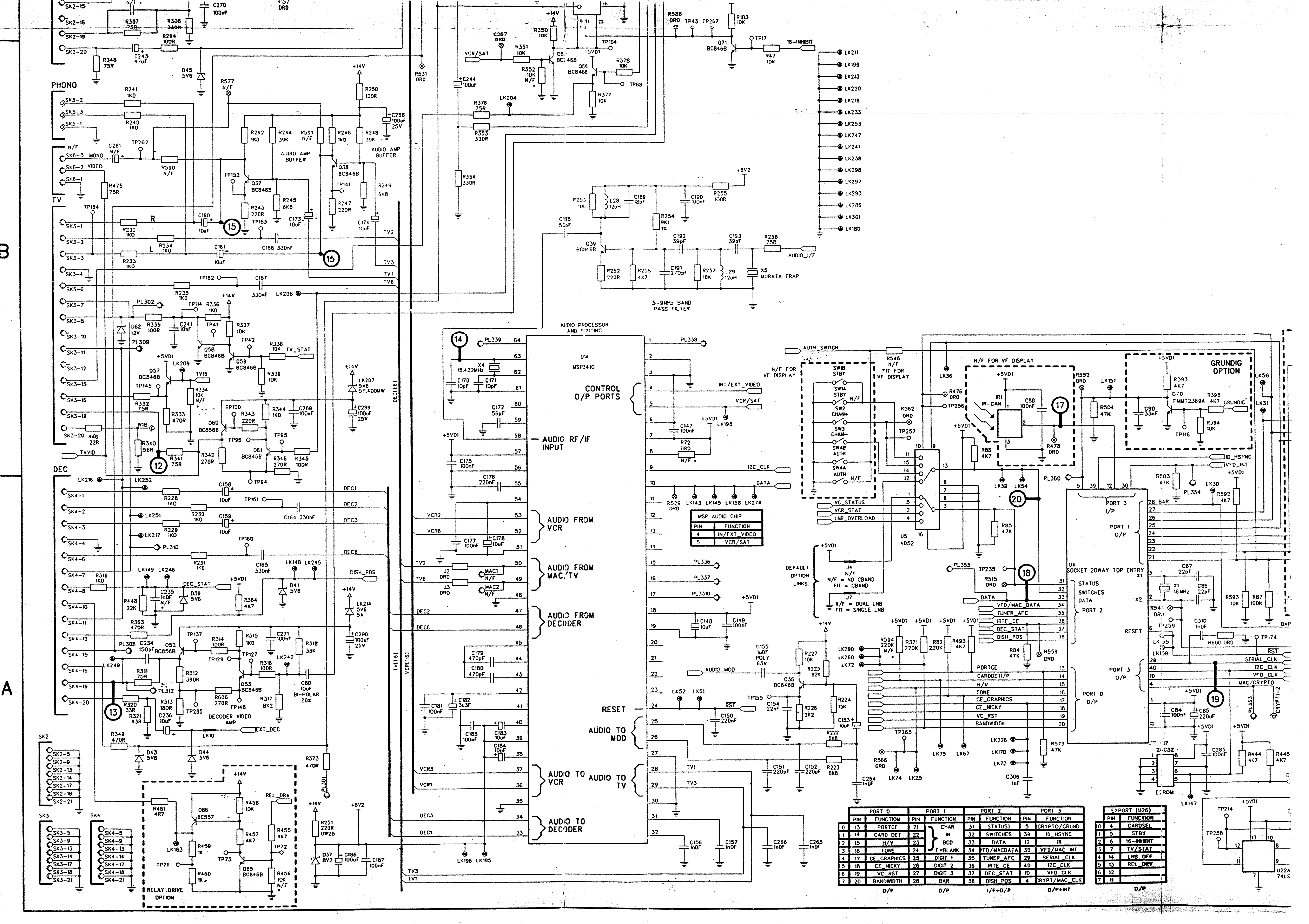

PACE
AMP
SOUND TRAP
ENERGY DISP CLAMP
+ FIT FOR IRD ONLY
CLAMP LEVEL
OSD CHIP
P0 CBAND
P1 LNB_1/2
P2 GR_ON_NOISE
P3 CLAMPED-DEC-VID
VIDEO SOURCE SELECT
NON IRD OPTION (SYNC SEP)
VIDEO CRYPT GRAPHICS INSERTION
ONLY FIT FOR VF DISPLAY.
CLAMP FOR GRAPHICS
1.4V BOT SYNC APPROX
FILMNET OPTION
* C203 150pF = 6.5MHz
180pF = 5.8MHz
U21A HC4052
U18 HC4053
Q40 FMMT2369A
Q41 FMMT2369A
Q42 BC856B
Q43 BC856B
Q44 BC856B
Q47 BC846B
Q48 BC856B
Q46 BC856B
Q94 FMMT2369A
Q49 BC856B
Q50 FMMT2369A
Q79 BC846B
Q90 BC846B
Q80 BC846B
Q81 BC856B
Q82 BC846B
Q83 BC846B
X6 17.734Mhz
X7 N/F
L32 4u7H
L33 33uH
L21 18uH
D59 1N4148
D60 1N4148
D61 4V7
+5VD1
+14V
+5V1
VC_STATUS
INT/EXT_VIDEO
EXT_DEC
INT_DEC
SAT
VC_I/P
CLMP_REF
BLOCK
CLAMPED
CHAR
VC_OUT
WHITE
BLACK
VSY
HSYNC
VCR_VID
CLAMPED-DEC-VID
GR_ON_NOISE
LNB_1/2
CBAND
+5VMOD
VFD_INT
VFD_CLK
VFD/MAC_DATA
VFD_FILAMENT
RST
-21V
PL1-1
PL1-2
PL1-3
PL1-4
PL1-5
PL1-6
PL1-8
PL1-7
PL1-9
PL1-10
PL331-1
PL331-2
PL331-3
TP107
TP130
TP133
③
④
⑤
⑩
⑪
㉗

D

C


+14V
ANTENNA INPUT
MOD1-2
MOD1-1
TV INPUT
R32 22R
C1 100uF 35V
Q1 BFR193
Q2 BFR193
L1 200nH
L2 200nH
L3 BC0403RID-B
R16 22R

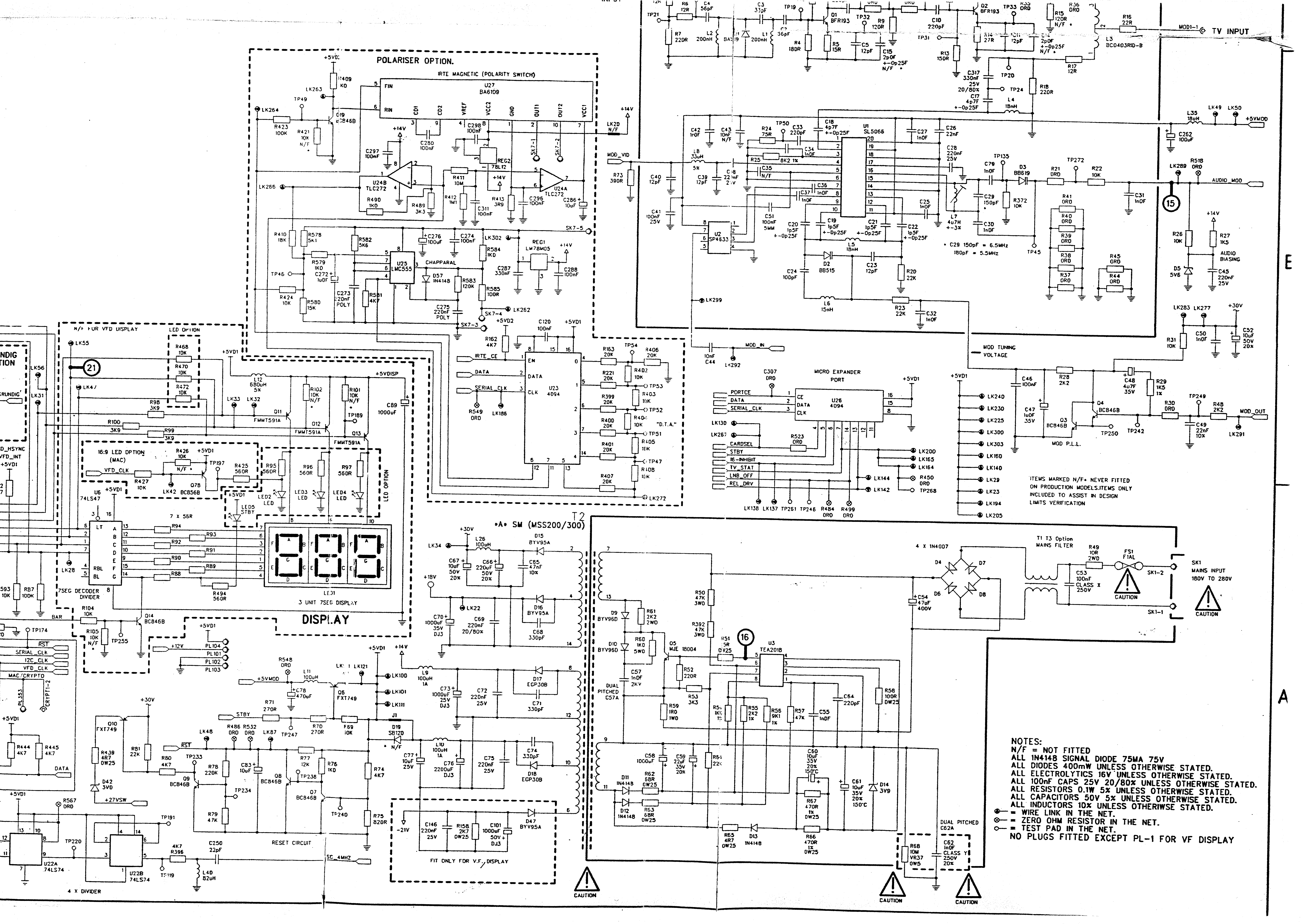
POLARISER OPTION.


PHONO
TV
DEC
SK2
SK3
SK4
AUDIO AMP BUFFER
AUDIO AMP BUFFER
DECODER VIDEO AMP
RELAY DRIVE OPTION
AUDIO PROCESSOR AND ROUTING
U14
MSP3410
CONTROL O/P PORTS
AUDIO RF/IF INPUT
AUDIO FROM VCR
AUDIO FROM MAC/TV
AUDIO FROM DECODER
RESET
AUDIO TO MOD
AUDIO TO VCR
AUDIO TO TV
AUDIO TO DECODER
5-9MHz BAND PASS FILTER
MURATA TRAP
AUDIO_I/F
16-INHIBIT
VCR/SAT
N/F FOR VF DISPLAY
FIT FOR VF DISPLAY
AUTH_SWITCH
GRUNDIG OPTION
U5
4052
U4
SOCKET 20WAY TOP ENTRY
STATUS
SWITCHES
DATA
PORT 2
PORT 3 I/P
PORT 1 O/P
PORT 3 O/P
PORT 0 O/P
DEFAULT OPTION LINKS.
J4 N/F = NO CBAND FIT = CBAND
J7 N/F = DUAL LNB FIT = SINGLE LNB
E2ROM
A
B

MSP AUDIO CHIP	
PIN	FUNCTION
4	IN/EXT_VIDEO
5	VCR/SAT

	PORT 0		PORT 1		PORT 2		PORT 3	
	PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
0	13	PORTCE	21	CHAR IN BCD F=BLANK	31	STATUS1	5	CRYPTO/GRUND
1	14	CARD DET	22		32	SWITCHES	39	ID_HSYNC
2	15	H/V	23		33	DATA	12	IR
3	16	TONE	24		34	VFD/MACDATA	30	VFD/MAC_INT
4	17	CE_GRAPHICS	25	DIGIT 1	35	TUNER_AFC	29	SERIAL_CLK
5	18	CE_NICKY	26	DIGIT 2	36	IRTE_CE	40	I2C_CLK
6	19	VC_RST	27	DIGIT 3	37	DEC_STAT	10	VFD_CLK
7	20	BANDWIDTH	28	BAR	38	DISH_POS	4	CRYPT/MAC_CLK
	O/P		O/P		I/P+O/P		O/P+INT	

	EXPORT (U26)	
	PIN	FUNCTION
0	4	CARDSEL
1	5	STBY
2	6	16-INHIBIT
3	7	TV/STAT
4	14	LNB_OFF
5	13	REL_DRV
6	12	
7	11	
	O/P	


POLARISER OPTION.
IRTE MAGNETIC (POLARITY SWITCH)
U27 BA6109
U24B TLC272
U24A TLC272
REG2 78L12
REC1 LM78M05
U25 LMC555
CHAPPARAL
U23 4094
IRTE_CE
DATA
SERIAL_CLK
N/F FOR VFD DISPLAY
LED OPTION
16:9 LED OPTION (MAC)
VFD_CLK
U6 74LS47
7SEG DECODER DIVIDER
LED1
3 UNIT 7SEG DISPLAY
DISPLAY
RESET CIRCUIT
STBY
U22A 74LS74
U22B 74LS74
4 X DIVIDER
SC_4MHZ
FIT ONLY FOR V.F. DISPLAY
A SM (MSS200/300)
T2
TV INPUT
MOD1-1
U1 SL5066
U2 SP4633
MOD_VID
MOD_IN
AUDIO_MOD
AUDIO BIASING
+5VMOD
MOD TUNING VOLTAGE
MOD P.L.L.
MOD_OUT
* C29 150pF = 6.5MHz
180pF = 5.5MHz
MICRO EXPANDER PORT
U26 4094
PORTCE
CARDSEL
16-INHIBIT
TV_STAT
LNB_OFF
REL_DRV
ITEMS MARKED N/F* NEVER FITTED ON PRODUCTION MODELS.ITEMS ONLY INCLUDED TO ASSIST IN DESIGN LIMITS VERIFICATION
U3 TEA2018
DUAL PITCHED C57A
DUAL PITCHED C62A
4 X 1N4007
T1 T3 Option MAINS FILTER
FS1 F1AL
SK1 MAINS INPUT 180V TO 280V
CAUTION
E
A

NOTES:
N/F = NOT FITTED
ALL 1N4148 SIGNAL DIODE 75MA 75V
ALL DIODES 400mW UNLESS OTHERWISE STATED.
ALL ELECTROLYTICS 16V UNLESS OTHERWISE STATED.
ALL 100nF CAPS 25V 20/80% UNLESS OTHERWISE STATED.
ALL RESISTORS 0.1W 5% UNLESS OTHERWISE STATED.
ALL CAPACITORS 50V 5% UNLESS OTHERWISE STATED.
ALL INDUCTORS 10% UNLESS OTHERIWSE STATED.
●— = WIRE LINK IN THE NET.
⊗— = ZERO OHM RESISTOR IN THE NET.
○— = TEST PAD IN THE NET.
NO PLUGS FITTED EXCEPT PL-1 FOR VF DISPLAY